



INDIANA DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

We Protect Hoosiers and Our Environment.

Michael R. Pence
Governor

Thomas W. Easterly
Commissioner

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Indianapolis, Indiana 46204
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Toll Free (800) 451-6027
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June 4, 2013

ArcelorMittal Indiana Harbor, LLC
Attn: Mr. Tom Barnett, Manager-Environmental Technology
3001 Dickey Road
Mail Code 001
East Chicago, Indiana 46312

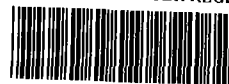
Dear Mr. Barnett:

Re: Hydrogeological Investigation Report/SAP
Clark RWS I Landfill
Lake County
FP 45-28

We reviewed your Response to Comments dated April 19, 2013 (VFC #68094086) regarding your Hydrogeological Investigation Report (Hydro Report) dated August 28, 2012 (VFC #66825073) and your Sampling and Analysis Plan (SAP) dated August 2012 (VFC #66825073, p. 61-102). While your response to our comments is adequate, we would like to clarify our position concerning the timeframe to submit the updated SAP, the proposed monitoring network, and the laboratory analytical methods.

1. You may submit the updated SAP within 30 days after receiving this letter.
2. The proposed shallow monitoring network appears sufficient for initiating a detection monitoring (Phase I) program considering the site-specific conditions at the Clark RWS I Landfill. However, if we require an assessment monitoring (Phase II) program or a corrective action program in the future, a deep monitoring network may be necessary to effectively determine the nature and extent of contamination.
3. Your request to use SW-846 Method 8270 for laboratory analysis of polycyclic aromatic hydrocarbons (PAHs) instead of SW-846 Method 8270 SIM is acceptable under the following conditions:
 - a. Laboratory analysis utilizes the most recent method, currently SW-846 Method 8270D.
 - b. Laboratory analysis using SW-846 Method 8270D is capable of obtaining detection limits equivalent to or below maximum contaminant levels (MCLs) for all PAHs. If laboratory analysis using this method cannot obtain detection limits for all PAHs equivalent to or below MCLs, SW-846 Method 8270 SIM will be necessary to ensure MCLs are obtainable.

US EPA RECORDS CENTER REGION 5



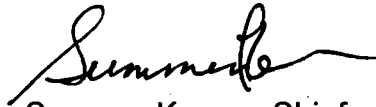
1004176

This letter contains the following deadlines for submittal of requested information: well installations must be completed within 180 days after receipt of this letter; a revised post-closure plan (including all boring logs and construction details for all wells and piezometers installed at the facility and updated financial assurance) must be submitted within 60 days after completing the well installations; and a revised Sampling and Analysis Plan (SAP) must be submitted within 30 days after receipt of this letter. The approval letter for your revised post-closure plan will include updated post-closure maintenance and monitoring requirements.

Public records for your facility are available in IDEM's Virtual File Cabinet (VFC) at www.IN.gov/idem.

If you have any questions concerning this letter, please call (800) 451-6027, press 0, and ask for Alicia Brown, or ask for extension 2-8734, or dial direct at (317) 232-8734.

Sincerely,



Summer Keown, Chief
Solid Waste Permits Section
Office of Land Quality

cc: Lake County Health Department
Lake County Commissioners
IDEM Northwest Regional Office
Lake County Solid Waste Management District
Jonathan Adenuga, USEPA Region 5
Steve Kornder, AECOM



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February 4, 2013

ArcelorMittal Indiana Harbor, LLC
Attn: Mr. Tom Barnett, Manager-Environmental Technology
3001 Dickey Road
Mail Code 001
East Chicago, Indiana 46312

Dear Mr. Barnett:

Re: Hydrogeological Investigation Report/SAP
Clark RWS I Landfill
Lake County
FP 45-28

We reviewed your Hydrogeological Investigation Report (Hydro Report) dated August 28, 2012 (VFC #66825073) and your Sampling Analysis Plan (SAP) dated August 2012 (VFC #66825073, p. 61-102). The Hydro Report is based on the approved Hydrogeology Study Plan dated February 11, 2009, and is submitted as part of Clark Landfill's post-closure requirement.

Based on the information provided, we have concluded that the Hydro Report and SAP are inadequate. Please review and respond to our comments as recommended below:

1. We agree with the installation of the additional downgradient wells MW-205S, MW-206S, and MW-207S. However, we will require additional downgradient wells if future potentiometric mapping indicates they are necessary for implementing an effective detection monitoring program.
2. Ground water elevation measurements taken since installation of the current monitoring system in 2010 indicate there is a very low hydraulic gradient (0.0004 to 0.0009 feet per foot) across the site. Thus, the number and placement of wells is critical for determining accurate ground water quality and flow directions.

Currently, there is a large horizontal distance between wells MW-201S and MW-202S (approximately 1800 feet) and wells MW-202S and MW-204S (approximately 1300 feet). Based on potentiometric contouring, the hydraulic location of MW-204S varies between upgradient, downgradient, and sidegradient; and the hydraulic location of MW-201S may at times be downgradient of the solid waste landfill boundary, even if upgradient of the current wells. Furthermore, based on provided maps, the location of MW-204S is within the solid waste landfill boundary. Because of these

findings, MW-201S and MW-204S may serve best as piezometers and not ground water quality monitoring points at this time. Therefore, we recommend the installation of two additional upgradient monitoring wells; one between MW-201S and MW-202S and one between MW-202S and MW-204S.

3. The saturated thickness of the uppermost aquifer is approximately 40 feet and predominantly comprised of slag-fill with the exception of the bottom one to two feet of native sand. Contaminated plumes can migrate in a downward direction due to dense phase non-aqueous liquids and/or dissolved constituents that may increase density above uncontaminated ground water. The "negligible upward flow gradient" (-0.0014 to -0.0004 feet per foot) measured once in December 2005 does not remove this concern. Furthermore, as documented in the *Clark Landfill (Group B) RCRA 3013 Order Investigation Report (RCRA 3013)* dated February 2012; a toe failure in 1997 caused a portion of the landfill foundation (approximately six acres) to move horizontally and vertically. Since the waste slide mass dropped 30 to 40 feet, there is likely a portion of previously unsaturated slag-fill and waste at an unknown depth below the ground water table. Because of these findings, deep screened interval wells are necessary for an effective detection monitoring program. Therefore, we recommend the installation of deep screened interval wells at the base of the uppermost aquifer at all monitoring locations, except at MW-201S and MW-204S since; they will be serving as piezometers.
4. We agree with the proposed Phase I constituents (field pH, field specific conductance, field temperature, field turbidity, boron, chloride, ammonia nitrogen, sodium, COD, total phenolics, methylene chloride, 1,1-dichloroethane, toluene, benzene, 1,2-dichloroethene, ethyl benzene, and 2-butanone). However, the proposal is incomplete. Specifically, based on waste streams from your facility and similar facilities (329 IAC 10-29-6(c)) and the *RCRA 3013*, the facility needs to add the following constituents to their Phase I constituent list:
 - a. Metals (dissolved): antimony, arsenic, beryllium, cadmium, chromium, iron, lead, nickel, thallium, vanadium, and zinc.
 - b. Volatile organic compounds (VOCs): chloroform, o-xylene, m-xylene, and p-xylene.
 - c. Polycyclic aromatic hydrocarbons (PAHs): acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

Consequently, these constituents will comprise the facility's Phase I constituent list.

5. The facility proposed Phase II constituents. However, based on 329 IAC 10-29-7, the commissioner will establish the Phase II constituents if the facility enters into a Phase II monitoring program. Therefore, the proposed Phase II list is invalid. Various portions of the SAP specify Phase I and Phase II constituents. Please revise the applicable portions of the SAP to incorporate the Phase I constituents noted above and to remove the Phase II constituents.
6. Based on the findings of our review of the Hydro Report, the facility needs to submit a revised post-closure plan within 60 days after completing the well installations. The revised plan should include all boring logs and construction details for all wells and piezometers installed at the Clark RWS I Landfill and updated financial assurance. Our approval letter for the revised post-closure plan will include updated post-closure maintenance and monitoring requirements.
7. We recommend that all future potentiometric maps depict the surface water elevation measurements taken from the intake flume monitoring point SW-301. However, the facility needs to obtain these measurements on the same day as the ground water elevation measurements from the monitoring well network. Therefore, the facility needs to modify Section 3.1.1, Water Level Monitoring, accordingly.
8. Section 3.1, Groundwater Sample Collection Overview, states "... samples analyzed for metals will be submitted to the laboratory unfiltered for total metal analyses." Unfiltered metallic samples are not necessary at this time. However, we require field filtering of all metallic samples using a 0.45 micron filter. Please modify Section 3.1 accordingly.
9. In Section 3.1, you propose the use of a peristaltic pump for purging and sampling. The proposed use of a peristaltic pump is unacceptable as it de-gases the volatile organic compounds (VOCs), which results in estimated results. The SAP must specify which equipment will be used to collect VOCs. We recommend the use of dedicated or properly decontaminated bladder pumps, or dedicated or disposable bailers. Please modify Section 3.1 accordingly.
10. Section 3.1 proposes the use of low-flow (Micro-Purge) purging and sampling techniques. We agree with this proposal. However, the SAP did not fully describe the techniques necessary for properly implementing low-flow purging and sampling. Specifically, the sampler needs to monitor drawdown, which must not exceed 0.3 feet during purging and sampling.

The stabilization procedure of the low-flow sampling technique indicates that purging will be considered complete when values of pH, temperature, specific conductance, and dissolved oxygen are within 10% for three consecutive readings. However, the IDEM guidance indicates that

stabilization criteria is $\pm 10\%$ for turbidity and dissolved oxygen, 3% for conductivity and temperature, ± 10 microvolts for oxygen-reduction (redox), and ± 0.1 for pH.

Please revise Section 3.1 of the SAP to include this low-flow sampling requirement and stabilization criteria as specified in the IDEM "Micro-Purge Sampling Option" at the IDEM website:
http://www.IN.gov/idem/files/remediation_tech_guidance_micro-purge.pdf.

12. The facility lists SW-846 Method 6020 in Tables 1 and 2 of the SAP. Please revise Tables 1 and 2 to indicate SW-846 Method 6020A. Additionally, Tables 1 and 2 have asterisks in several of the columns yet, there is no corresponding footnote. Please include a footnote to clarify the information.

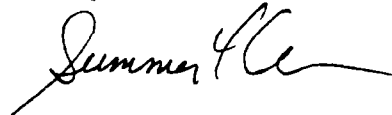
We recommend Method 8270 SIM for PAHs.

This letter contains the following deadlines for submittal of requested information indicated above: well installations must be completed within 180 days after receipt of this letter; a revised post-closure plan (including all boring logs and construction details for all wells and piezometers installed at the facility and updated financial assurance) must be submitted within 60 days after completing the well installations; and a revised Sampling and Analysis Plan (SAP) must be submitted within 90 days after receipt of this letter. The approval letter for your revised post-closure plan will include updated post-closure maintenance and monitoring requirements.

Public records for your facility are available in IDEM's Virtual File Cabinet at www.in.gov/idem.

If you have any questions concerning this letter, please call (800) 451-6027, press 0, and ask for Alicia Brown, or ask for extension 2-8734, or dial direct at (317) 232-8734.

Sincerely,



Summer Keown, Chief
Solid Waste Permits Section
Office of Land Quality

cc: Lake County Health Department
Lake County Commissioners
IDEM Northwest Regional Office
Lake County Solid Waste Management District
Jonathan Adenuga, USEPA Region 5
Steve Kornder, AECOM



Prepared for:
ArcelorMittal Indiana Harbor, LLC
East Chicago, IN

Prepared by:
AECOM
Milwaukee, WI
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August, 2012

Clark Landfill Hydrogeological Investigation Report



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ArcelorMittal Indiana Harbor, LLC
East Chicago, IN

Prepared by:
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August, 2012

Clark Landfill Hydrogeological Investigation Report



Prepared By Lanette L. Altenbach, C.P.G.



Reviewed By Steven C. Kornder, Ph.D.

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1.0 Introduction

The Clark Landfill is a Type 1 Restricted Waste Disposal Facility located on the interior of the ArcelorMittal Indiana Harbor (IH-West) steel mill facility located at 3001 Dickey Road in East Chicago, Lake County, Indiana. The location can be further described as in Township 37 North, Range 9 West, Sections 9 and 10. The site location is illustrated on Figure 1-1.

The Clark Landfill is located in the central section of the peninsula and occupies approximately 43 acres. ArcelorMittal received final closure certification for the landfill from IDEM on December 15, 2010.

1.1 Purpose and Scope

This Hydrogeologic Investigation Report has been prepared to describe the geologic and hydrogeologic setting at the Clark Landfill site in preparation for post-closure groundwater monitoring as required under 329 Indiana Administrative Code 10-24-4. Included in this report is a discussion of four groundwater monitoring wells installed for this hydro study and a recommendation to add three additional downgradient monitoring well locations for post-closure monitoring. The locations were selected based on the groundwater flow direction determined by this hydro-study with the four existing monitoring wells.

The post-closure groundwater monitoring plan was included in a landfill permit application that was approved by IDEM on April 1, 2001. The original 1999 groundwater sampling and analysis plan has been updated to include current contact names and ownership and is provided in Appendix A.

2.0 Regional Hydrogeologic Setting

The data presented below includes published regional information and general area-wide information reported in the *Hydrogeologic Conditions Report* (STS, 2008).

2.1 Topography

The Clark Landfill is located in the northwest portion of Lake County, Indiana on the shoreline of Lake Michigan on a man-made peninsula. The peninsula is bordered on two sides by Lake Michigan and one side by Indiana Harbor. The landward side of the peninsula is bordered by the east-west trending railroad grade. The ground surface of the peninsula is relatively flat and varies from +595 feet Mean Sea Level (MSL) to +600 feet MSL (Figure 1-1). The topography of the landfill, as modified with the cap constructed as part of landfill closure depicts the lowest landfill elevation at 580 feet MSL on the intake flume (south) side of the landfill and the highest elevation of the center of the cap at 670 feet MSL. The topography of the landfill is depicted on Figure 2-1 Site Layout.

2.2 Hydrology/Surface Water Drainage

2.2.1 Surface Water

Regionally, surface water flow is towards Lake Michigan, Indiana Harbor and Indiana Harbor Canal. On the Peninsula, however, surface water is collected via a combined process water/stormwater collection system. All surface water is collected, treated and recycled by the combined process water/stormwater collection treatment system or it is allowed to infiltrate into the ground. As an additional precaution to prevent surface water runoff off site, the perimeter of the Peninsula is diked.

Surface water around the Clark Landfill is collected in a perimeter drainage swale. The drainage swale is graded and drainage is directed to the Peninsula's combined process water/stormwater collection system.

2.2.2 Lake Michigan Levels

Although the flow in the Indiana Harbor Canal is typically toward Lake Michigan, if water levels in Lake Michigan rise relative to those in the canal, backwater effects and flow reversals can occur. With no other outlets, normal flow accumulates within the canal until equilibrium between the lake and canal levels is re-established. Flow reversals are typically short in duration, whereas backwater (gradient) effects on water levels can persist for longer periods of time.

In addition to long-term lake level fluctuations, seiches (temporary buildups of lake water near the shore caused by local atmospheric pressure and wind) can cause short-term fluctuations of more than 3 feet within a few hours along the southern lakeshore. Long-term water level changes in Lake Michigan immediately affect levels in parts of Indiana Harbor and the canal, but seiche fluctuations are not fully transported upstream. Short-term seiche fluctuations are damped by the interaction of surface water and groundwater.

Lake Michigan levels recorded from six gauges in Lakes Michigan and Huron, and reported as a monthly average (in feet mean sea level) between 1960 and 2011, show a record low of 576.05 occurring in March 1964 and a record high of 582.35 recorded in October 1986. The data for 2001-

2011 indicate that Lake Michigan levels are on the low side of the February average of 578.4 feet ranging from a low of 576.38 in December 2008 to a high of 578.87 in July-August 2009. Graphs of the Lake Michigan levels are included as Appendix B.

2.2.3 Meteorology

The climate of northwestern Indiana is continental and is characterized by hot, humid summer and cold winters. The region received an average of about 37 inches of precipitation and 20 inches of snowfall annually (National Oceanic and Atmospheric Administration, 1992). Precipitation records maintained by the Indiana Department of Natural Resources indicate that for the time period of January 2010 through May 2011, the total measured precipitation is 105% of the normal precipitation expected for the northwestern Indiana region.

2.3 Regional Geology

2.3.1 Physiography

IH-West is located along the south shore of Lake Michigan in Lake County, East Chicago, Indiana. Lake County has been divided into three distinct physiographic regions:

- 1) The Calumet Lacustrine Plain
- 2) The Valparaiso Morainal Area
- 3) The Kankakee Outwash and Lacustrine plain

The locations of the physiographic regions in relation to IH-West are depicted on Figure 2-2. IH-West is located within the Calumet Lacustrine Plain, which extends from the southern shoreline of Lake Michigan and is bounded to the south by the Valparaiso Moraine 12 miles south of Lake Michigan. The Calumet Lacustrine Plain is of generally low relief and consists of deposits from glacial Lake Chicago. Three distinct stages of lake level lowering deposited sediments that consist of sand, silt, clay and paludal deposits of muck and peat. These sediments were the result of lake-bottom and near shore deposits of glacial Lake Chicago. Sands of this unit are considered locally to comprise the uppermost aquifer (hereinafter designated the Calumet Aquifer).

The Valparaiso Moraine extends around the southern tip of Lake Michigan from Illinois through northwestern Indiana and into Michigan. The Valparaiso Moraine is a complex system of rolling hills in an area approximately paralleling the southern shore of Lake Michigan. This is a composite of several end moraines that represent the terminus of the retreating glacial ice. This region is divided into at least two till units of different texture and composition. The upper till unit is generally a silt-clay loam. The lower till unit is more densely compacted and separated by layers of outwash sands and gravels.

The Kankakee Outwash and Lacustrine Plain (farther to the south) was formed during the last stages of glaciation as outwash, lake and river deposits. These deposits generally consist of sand and fine gravels.

2.3.2 Unconsolidated Deposits

On a regional basis, surficial soils are mapped as Tawas Muck, Capability Unit IIIw-8, Urban Land and Capability Unit VIIIs-1. A description of these surficial soils is provided in Table 2-1 (SCS, July 1972). A surficial geology map is presented as Figure 2-3. IH-West is located within the northwestern part of the Calumet Lacustrine Plain. The geology of the northwestern part of the Calumet Lacustrine Plain

consists of glacial and post glacial deposits over bedrock. The uppermost materials are unconsolidated fill (i.e., modified load, slag and/or lake fill) and native deposits (predominately Calumet sands). Urban fill, consisting mainly of slag and dominated by sand and gravel size materials, has been deposited over the natural sands, especially in the industrial zone adjacent to the Lake Michigan shoreline. Filling began in the early 1900s under Indiana Code (4-18-13) which encouraged the building of artificial land along the Indiana shoreline using urban fill, primarily slag from the Steel Industry. The filling was generally completed by the mid-1980s. As of 1979, about 10 square miles of man-made land had been constructed along the southern Lake Michigan shoreline.

A succession of dense silts and clays containing occasional lenses of sand and gravel lies below the Calumet sands. The sediments are of glacial and lacustrine origin and are exposed to the south of the industrial/residential area extending southward from the Lake Michigan shoreline. These are referred to as the glacial clay till/lacustrine clay or clay unit. The top of the clay unit has been compacted in most places and can be locally weathered. Younger deposits overlie the clay unit, particularly in the northern Calumet Lacustrine Plain where eolian and lacustrine sands are predominant. Peat and muck are occasionally found close to the top of this unit. Silurian bedrock is found below the clay unit. A generalized geologic cross-section is also shown in Figure 2-3.

2.3.3 IH-West Peninsula Geology

In general, the subsurface consists of three unconsolidated layers; a non-native slag-fill overlying a native eolian and water deposited sand over a glacial till/lake deposit clay. The clay layer is regionally an aquitard with permeabilities several orders of magnitude lower than the sand and slag-fill above. While the clay was not penetrated, dolomite bedrock is generally encountered at 115 to 215 feet below ground surface (bgs).

The slag-fill is characterized as a granular material that ranges from fine sand to coarse gravel in size, ranges from brown to black in color, and is medium dense to extremely dense. The slag-fill varies in thickness from a few feet on the landward side to a maximum of approximately 52 feet on the north end of the peninsula. The fill thickness generally increases to the north across the peninsula to Lake Michigan as would be expected given the nature and timing of filling. A slag-fill isopach is provided for the IH-West peninsula in Figure 2-4.

The Calumet sand can be described as a fine to medium-grained, gray, medium dense to loose, sand and silty sand. Occasional thin (one to four feet thick) layers of coarse sand to fine gravel were encountered primarily on the landward side of the peninsula. Most of the coarse material layers occurred along the historic shoreline. The elevation of the top of the sand ranges from a low of approximately 547 feet MSL (50.5 feet bgs) on the north end of the peninsula to a high of 594 feet MSL (1.8 feet bgs) located approximately within the former east-west trending shoreline. In general, the hydraulic conductivity of the Calumet Sand decreases with depth. A structure contour map of the top of the Calumet sand is shown in Figure 2-5. An isopach map of the Calumet sand is provided for the IH-West peninsula in Figure 2-6.

The clay till/lacustrine clay is encountered at a depth of about 35 to 55 feet bgs. The thickness of the clay was determined based on previous work on the peninsula and published literature. The clay is approximately 80 to 100 feet thick and acts as a regional aquitard to protect the lower bedrock aquifer. A structure contour map of the top of the clay is shown in Figure 2-7. A structure contour map of the top of bedrock is shown in Figure 2-8.

2.3.4 Bedrock Conditions

Silurian and Devonian limestones, dolomites, and shales directly underlie the unconsolidated glacial deposits across most of the region. The Devonian units include, from youngest to oldest, the Antrim Shale, the Traverse Limestone Formation and the Detroit River Limestone Formations. The Silurian age units consist of limestone and dolomite bedrock units. From youngest to oldest, they include the Salina Formation, Wabash Formation, Louisville Limestone, Salamonie Dolomite and Brassfield Limestone. These geologic units are depicted on a stratigraphic column in Figure 2-9. The erosional bedrock surface has about 70 feet of relief in the area and slopes gently toward Lake Michigan. Regional bedrock depths reported by the USGS range from 115 to 215 feet below grade (Fenelon and Watson, 1993).

The Lake County area of northwestern Indiana overlies the Kankakee arch bedrock formation, which has a bedrock high separating the Michigan Basin to the northeast from the Illinois Basin to the southwest. The bedrock is of Paleozoic age and consists of a succession of about 3,000 feet of sandstones, shales, and carbonates resting on older Precambrian granite (Hartke et al, 1975).

2.4 Regional Hydrogeology

Numerous studies of the regional hydrogeology have been conducted by USGS, Indiana State Geological Survey, and local industry. Approximately 87% of the total domestic water in Lake and Porter Counties is supplied by Lake Michigan. The remaining 13% is derived from groundwater. Nearly all the groundwater is produced in the southern portion of these two counties from the Quaternary and Silurian-Devonian aquifers.

The shallow Quaternary aquifer in the northern portion of the region is not extensively utilized in the production of groundwater. Cambrian and Ordovician aquifers underlie the shallower aquifers but are also not significantly developed in either county. The stratigraphic and hydrogeologic relationships of the aquifers are illustrated on Figure 2-10.

As shown in Figure 2-10 the Quaternary units overlie the Devonian (where present) and Silurian units. The Devonian units which produce groundwater include, from youngest to oldest, the Antrim Shale, the Traverse Limestone Formation and the Detroit River Limestone Formations. The Silurian age aquifers consist of limestone and dolomite bedrock units. From youngest to oldest, they include the Salina Formation, Wabash Formation, Louisville Limestone, Salamonie Dolomite and Brassfield Limestone. The Calumet Aquifer is underlain by an aquitard comprised of low permeability clay and till. No known hydraulic connections between the Calumet Aquifer and the underlying bedrock aquifers are documented. The following paragraphs describe each of these aquifers in greater detail.

Quaternary Aquifers – The Quaternary glacial deposits are separated into three aquifers; which are the Calumet, Valparaiso and Kankakee aquifers. Figure 2-10 illustrates the geographic and stratigraphic relationships between the three Quaternary aquifers.

Calumet Aquifer – The Calumet water table aquifer is exposed at the ground surface, except where urban fill is present, and is located in the northern portions of Lake and Porter Counties. It extends from Lake Michigan in a wedge shaped area encompassing the northern quarter of Lake County and northern tenth of Porter County. The Calumet aquifer is a beach deposit consisting of eolian and water-laid fine sands which yield good quality fresh water with moderately high permeabilities. The thickness of sand varies from 5 to 75 feet. An impermeable clay till is the basal unit of this aquifer.

Valparaiso Aquifer – The Valparaiso aquifer is partially confined. It consists of heterogeneous layers of sand and gravel with intermixed clay and silt lenses. Glacial till overlies and underlies the Valparaiso aquifer; however, it is known to crop out in some areas within the Valparaiso Morainal Plain. The aquifer ranges from 10 to 90 feet thick and is located 10 to 80 feet below the ground surface. Water quality is poorer than in the other two Quaternary aquifers.

Kankakee Aquifer – The Kankakee aquifer extends from the Valparaiso Moraine to the Kankakee River. This aquifer is composed primarily of sand, with some gravel and discontinuous silt and clay lenses. It is an unconfined aquifer which outcrops at the surface and is in hydraulic connection with the Valparaiso aquifer (see Figure 2-10). The Kankakee aquifer ranges in thickness from 10 to 50 feet with very good quality fresh water.

Silurian and Devonian Aquifers – The Silurian dolomite and limestone aquifers constitute the shallow bedrock aquifer system in Lake County. They are not in hydraulic connection with shallower Quaternary aquifers. These deposits dip to the east and crop out towards the west. The upper 200 to 300 feet of the carbonate bedrock system has been weathered and has solution features such as joints and fractures. This zone is the most productive with the shallow bedrock aquifer system. The depth to this aquifer increases from 15 feet in Kankakee Outwash Plain to 270 feet in the Valparaiso Moraine in Lake County. Water quality is generally good.

Cambro – Ordovician Aquifers – These aquifers underlie the Silurian-Devonian aquifers and have not been extensively developed due to the great depth to water and the marginal quality of the water.

Regionally, the uppermost aquifer is the Calumet Aquifer. The saturated thickness of the Calumet Aquifer ranges from 0 to 65 feet with an average thickness of 20 feet. The horizontal hydraulic conductivity of the aquifer within Lake County is estimated to range from 3.5×10^{-3} to 4.6×10^{-2} centimeter per second (cm/s) with an average of 2.1×10^{-2} cm/s (Rosenhein and Hunn, 1968). Other regional estimates of hydraulic conductivity for this aquifer range from 4.0×10^{-4} to 6.4×10^{-2} cm/s.

Because the basal clay unit of the Calumet Aquifer is laterally extensive and thick (55 to 75 feet) and has a vertical hydraulic conductivity of 10^{-7} to 10^{-8} cm/s, it serves as an aquiclude, effectively limiting vertical flow between the Calumet Aquifer above and the Silurian – Devonian Aquifer below. Hydraulic conductivities in the clay and till layer are on the order of 10^{-6} cm/sec or slower. Given the differences in hydraulic conductivity between the upper and basal portions of the aquifer and the vertically and laterally extensive nature of this deposit, the clay and till unit will retard the vertical migration of any potentially impacted groundwater. Therefore, regionally the uppermost aquifer of interest is the Calumet Aquifer.

Within the region, the water table ranges in position from the land surface in low interdunal areas to 50 to 90 feet below ground in the higher dunes. It is generally less than 15 feet below ground through most of the region. Based on a map showing the potentiometric surface of the unconsolidated aquifer (Figure 2-11), regional flow is towards Lake Michigan. In general, groundwater is unconfined and mounded between the major surrounding surface water bodies, with the overall flow direction towards these surface water bodies. No major groundwater flow variations are observed in areas where flow is predominantly in the sand relative to areas where flow is predominantly in the urban fill (Baker, 1993; Fenelon and Watson, 1993).

The overall water balance for the Calumet Aquifer consists of inflow by way of rainfall and surface infiltration and outflow as discharge to local surface waters. A regional groundwater divide (divergence in flow) exists between Lake Michigan and the Grand Calumet River. Most of the groundwater within the region discharges to Lake Michigan or to the Grand Calumet River (Watson et al., 1989). USGS model simulations of regional groundwater flow have estimated that about 10 cubic feet per second (cfs) discharges to the Grand Calumet River, 4 cfs to Lake Michigan along a 25-mile section of lakeshore in northwestern Indiana, and unquantified amounts to sewers or ditches (Fenelon and Watson, 1993).

2.4.1 IH-West Peninsula Hydrogeology

The upper hydrogeologic unit on the landward portion of peninsula consists of the Calumet Aquifer, which transitions into fine-grain sediments with distance from the shoreline. These are overlain by slag-fill that was used to construct the peninsula. Beneath Calumet Aquifer is laterally extensive basal clay unit that serves as an aquiclude. The upper hydrogeologic unit appears to be a water table or unconfined unit that consists of saturated slag-fill, historical pre slag-fill lake bottom sediments and Calumet Aquifer sand. Along the historical shoreline, this hydrogeologic unit consists almost entirely of Calumet Aquifer sand with a saturated thickness of about 33 feet. However, with increasing distance from the shoreline the Calumet thins rapidly and transitions into historical pre slag-fill sediments with a thickness of as little as 1-2 feet. Thus, over much of the peninsula, the saturated water table unit consists of slag-fill over a thin sand or fine grain sediment layer.

Groundwater elevations for the upper hydrogeologic unit on the peninsula ranged from approximately 578 feet MSL to 586 feet MSL in December 2005. In general, groundwater elevations are mounded, or highest near the center of the peninsula. Since March 2010, following the installation of the monitoring wells, groundwater elevations in the vicinity of Clark Landfill have ranged from about 578 to 581 feet MSL. Intake flume water levels are slightly lower than the groundwater elevations and have ranged from 576.5 to 579.2 feet MSL of the same period.

3.0 Field, Drilling and Laboratory Procedures

This section describes the procedures used for installation of four soil borings/monitoring wells advanced to determine locations for post closure monitoring. The four boring/well locations (MW-201S, MW-202S, MW-203S and MW-204S) were placed on the periphery of the landfill on the north, south, east and west sides to evaluate the nature of subsurface materials as well as to determine the groundwater flow direction. The monitoring well locations are depicted on Figure 2-1. The procedures described below will also be used for three additional downgradient monitoring wells (MW-205S, MW-206S and MW-207S) that are proposed to be installed with IDEM approval. The three proposed wells are further discussed in Section 5.1 and depicted on Figure 5-1.

Soil samples for analytical testing and grain size analysis were collected during boring advancement. Surface slag-fill samples were not collected because the top two feet at the Clark Landfill are composed of clean limestone used for capping. The four borings were completed as groundwater monitoring wells screened across the water table.

3.1 Borehole Drilling

Soil borings were drilled at each well location prior to groundwater monitoring well installation for the existing wells MW-201S, MW-202S, MW-203S and MW-204S. The borings were advanced using a truck mounted auger drilling rig and hollow stem augers. The hollow stem augers had an 8-inch outside diameter and a 4 ¼-inch inside diameter. Well construction was completed inside the hollow stem augers. The annular space around the well screen and riser was successively backfilled (slowly) with a well graded sand and bentonite chips inside the augers which were slowly removed as well construction was completed.

3.2 Geologic Descriptions

Borehole lithology for each boring and well construction details for each well (MW-201S thru MW-204S) are provided on a borelog and well construction diagram which are included as Appendix C. The soils were classified by a site geologist. The soil descriptions include: soil grain size with appropriate descriptors; color; relative density and/or consistency; moisture content; stratification; texture/fabric/bedding; or other distinguishing features, as appropriate. These descriptors were evaluated and the soil classified according to the USCS. Fill materials do not have a USCS classification.

3.3 Monitoring Well Installation and Development

Monitoring wells were constructed inside the drill string after the desired depth of the well had been reached. The water table monitoring wells were constructed with a ten-foot long well screen to intersect the water table and to account for water table fluctuations (i.e. approximately four feet of screen above the water table and six feet below). The wells were constructed with new PVC casing and well screen, two-inches in diameter. The well screen was factory cut slot at 0.010-inch per slot. The filter pack extended one to two feet above the top of the screen and a fine sand seal was placed above the filter pack. The remaining annular space was sealed with coarse, chipped bentonite to within one-foot of the ground surface. A protective pipe and concrete surface seal completed the installation.

The monitoring wells were developed after the well was installed by surging and purging techniques. Surging created alternating negative and positive pressure on the water column forcing entrained solids in the filter pack into the water column. Remaining suspended solids were purged from the well using a submersible pump until the development water cleared, five well volumes of groundwater were removed, or field parameters stabilized. Well development field data is provided in Appendix D.

3.4 In-Situ Hydraulic Conductivity Testing

Hydraulic conductivity testing was conducted at the four monitoring wells to evaluate the hydraulic conductivity in the immediate vicinity of the landfill. The rising head method was used to evaluate the hydraulic conductivity. The rising-head test imposed a stress on the water bearing layer by instantaneously depressing the water surface and measuring the rate of water level recovery to equilibrium conditions. The water level was depressed by extracting a volume of water (e.g. removing a full bailer) or by using a pneumatic well manifold and inert nitrogen gas. The rate of water recovery was measured using a pressure transducer and data logger. One to three replicate tests were conducted on each monitoring well tested. Copies of the field data collected during the slug tests (both manual and transducer) are included as Appendix E.

Hydraulic conductivity values for each well were calculated using the Bouwer and Rice method (1976) in a readily available computer program (AQTESOLV Version 3.01.004 2000). Copies of the graphical output are also included in Appendix E.

3.5 Water Level Measurements

3.5.1 Surface Water Measurements

Surface water elevation measurements were obtained from the west end of the intake flume (SW-301). Surface water levels were measured using a standard water level indicator to the nearest 0.01 foot. The surface water measurements were taken at fixed reference points that had been surveyed for vertical control. The surveyed location is marked with permanent markers or is a readily identifiable location based on a written description. Staff gauges were not used because of the difficulty in maintaining the gauges under poor winter weather conditions. Measuring surface water elevations from known fixed points was not affected by weather.

3.5.2 Groundwater Level Measurements

Water levels in groundwater monitoring wells were measured with an electronic water level indicator from a measuring point scribed into the top of the monitoring well riser pipe. Water levels were measured by lowering the probe into the well until the device indicated that water had been encountered, usually with a constant buzz and a light. The groundwater level was recorded to the nearest 0.01 foot using the graduated markings on the water level indicator tape. This measurement, when subtracted from the measuring point elevation, yielded the groundwater elevation.

3.6 Decontamination Procedures

Field analytical equipment that came in direct contact with the sample or sample media was decontaminated before and after use, according to the procedures outlined below, unless manufacturers' instructions indicated otherwise.

1. Cleaned with tap water and laboratory detergent using a brush, if necessary, to remove particular matter and surface films.

2. Rinsed thoroughly with tap water.
3. Rinsed thoroughly with distilled de-ionized water and allowed to air dry.

3.7 Quality Control Procedures

QC procedures for surface water and groundwater measurements included duplicate or replicate measurements taken at the time of the measurement. The field logbook or data recording sheet serves as the quality assurance record for water or well depth measurements.

3.7.1 Calibration and Maintenance Procedures

Water level meters were calibrated and maintained in general conformance with the manufacturer's recommendations.

3.7.2 Data Validation

The field analytical data was validated by checking procedures used in the field, ensuring that field measurement equipment was properly calibrated, checking for transcription errors, and comparing the data to historic data or verifying its "reasonableness."

3.8 Laboratory Procedures

Soil samples from the screened interval of the monitoring well soil borings were submitted for grain size analysis. The grain size was determined using ASTM method C136. Copies of the grain size analyses are included in Appendix F.

4.0 Site Conditions

The description of site conditions includes a description of the local geology at the Clark Landfill as well as the hydrogeologic conditions that exist at the landfill.

4.1 Site Specific Geology

Regionally, the peninsula is mapped as “lake-fill land, slag”. The lake-fill land is composed primarily of slag with other solids (e.g., sand and gravel). The slag-fill has a maximum thickness of approximately 52 feet on the north end of the peninsula and the slag-fill thickness generally increases to the north. A fill thickness isopach map (Figure 2-4) has been generated from historic borelogs and data obtained from the 2005 RCRA investigation.

The slag-fill encountered on the peninsula can be characterized as a granular material that ranges from fine sand to coarse gravel in size and from brown to black in color. The slag is medium dense to extremely dense as measured by standard penetration tests during drilling.

The Calumet sands are found below the slag-fill on the peninsula. The Calumet sand is very thin under the peninsula; thins northward and transitions into historical lake bottom sediments. The structure contours for the top of the Calumet sand is depicted on Figures 2-5. The Calumet sand varies in thickness from 1.5 feet near Lake Michigan (adjacent to the North Lagoon) on the far northern end of the peninsula to a high of more than 40 feet at the south end of the peninsula along the historic shoreline. An isopach map of the thickness of the Calumet sand is provided as Figure 2.6. The Calumet sand is not exposed at the ground surface on the peninsula. The thinning of the sand further out into the lake is consistent with normal near-shore environments in lakes (see Figure 2-6). The slag-fill of the peninsula and the Calumet sand deposits are the principal hydrogeologic unit. Based on water level measurements it behaves hydraulically like a single unit.

Beneath the uppermost water table unit composed of the slag-fill and Calumet sand and above the bedrock is a hydraulic confining zone (aquitard) composed of glaciolacustrine clay and till. The clay till/lacustrine clay is encountered at a depth of 55 feet below grade in the vicinity of the Clark Landfill. The thickness of the clay was determined by soil borings conducted during prior investigations of the Clark Landfill. Based on this previous work on the peninsula and published literature, the clay appears to be roughly 80 to 100 feet thick. The top of the clay is relatively uniform at an elevation of +546 to +554 feet above mean sea level. The unit slopes gently to the southeast. A structure contour map of the top of the clay is included as Figure 2-7. The clay encountered in the deep wells was gray in color, and soft.

While the clay was not penetrated, the bedrock below the site has been characterized as Silurian dolomite which is encountered at a depth of roughly 125 to 150 feet below grade. This is generally consistent with regional bedrock depths reported by the USGS ranging from 115 to 215 feet below grade (Fenelon and Watson, 1993). These depths correspond to an elevation of +450 to +475 feet MSL. The bedrock surface dips downward towards Lake Michigan as depicted on Figure 2-8, the structure contour map of the top of bedrock. The bedrock elevation ranges from 442 feet msl (lakeside) to 490 feet msl (mainland).

4.2 Site Specific Hydrogeology

The upper hydrogeologic unit is the Calumet Aquifer landward of the shoreline. On the peninsula the uppermost hydrogeologic unit consists of saturated slag-fill and a thin layer of Calumet Aquifer sand. In the vicinity of the Clark Landfill the aquifer consists of slag-fill over a sand layer that is only a few feet thick.

4.2.1 Groundwater Flow

Monthly groundwater levels have been conducted at the four monitoring wells installed adjacent to the Clark Landfill since March 2010. Groundwater elevations since March 2010 are shown on Table 4-1 and hydrographs of the water levels over time are depicted on Figure 4-1. As shown in Figure 4-1 groundwater elevations typically vary between approximately 578 ft msl and 580 ft msl. Groundwater elevations at well MW-201S, located on the southwest corner of the Landfill, consistently indicated the highest groundwater elevations while groundwater elevations at well MW-203S, located adjacent to the intake flume along the southeastern edge of the Landfill, indicate the lowest groundwater elevations. Surface water elevations within the Intake Flume are generally 1.0 to 1.5 feet lower than monitoring well MW-203S.

The groundwater data for the Clark Landfill indicates that groundwater flow is generally toward the south-southeast, toward the intake flume. Monitoring data collected since February 2010 indicates that the groundwater flow conditions are similar throughout the calendar year. The groundwater flow is influenced locally by the intake flume. Water from the intake flume is continuously pumped to provide water for the mill's various steel-making operations, but maintains a level essentially identical to that of Lake Michigan. Groundwater contour maps are provided for selected months as Figures 4-2 through 4-14.

Horizontal groundwater gradients were calculated for representative months (April, August and October 2010; January, May, September and November 2011; and January and May 2012) for two well pairs along the flow path. The average horizontal hydraulic gradient at the Clark Landfill ranges from approximately 0.0008 to 0.0076 feet per foot for the MW-201S and MW-203S pair and -0.0001 to 0.0005 feet per foot for the MW-202S and MW-203S pair. The only slightly negative gradient observed at the well pair MW-202S and MW-203S is attributable to seiche event and is discussed in greater detail below. The average groundwater flow for the respective well pairs is variable from 217 to 1346 feet/year. The calculated hydraulic gradients and linear flow rate are summarized in Table 4-2.

With one exception, well MW-201S, located at the southwest corner of the landfill, has indicated the highest groundwater elevations. The May 4, 2010 result was recorded as an elevation slightly below MW-202S and MW-204S. This elevation appears to be an outlier attributable to recording error, but is not significant since the groundwater elevation at MW-201S was still above that of the MW-203S and the intake flume (i.e., groundwater flow was still toward MW-203 and/or the intake flume).

Well MW-203S, located southwest of the landfill along the intake flume, has indicated that lowest groundwater elevations. The groundwater elevations at MW-203S have consistently been above those of the intake flume (refer to Figure 4-1). Groundwater elevations at MW-203S have also been lower than those observed at MW-202S and MW-204S with one exception. On September 30, 2011 the groundwater elevations recorded at MW-202S, MW-203S and MW-204S were essentially identical. Notably on this date the highest intake flume elevation was also recorded. This appears to represent a potential Lake Michigan high water seiche event that temporarily influenced the groundwater elevations of the wells along the intake. September 30, 2011 was the only occurrence

where a seiche event temporarily influenced flow during the period of monitoring. Although other seiche events are evident in the data, there is no evidence to suggest that the high water seiche events appreciably change the direction of groundwater flow (i.e., predominant flow direction is toward the intake flume).

Vertical groundwater gradients were calculated using two existing well pairs near the landfill. The two well pairs (MW-903S/MW-903D and MW-904S/MW-904D) include one shallow (water table) well and one deep well (screened at the base of the Calumet sand). These two well pairs are located near to the Clark Landfill on either side of the intake flume as shown on Figure 4-14. The well pairs exhibited a negligible upward flow gradient likely attributable to surface water influences such as Lake Michigan (including the intake flume). Thus, a deep well was not installed adjacent to the Clark Landfill because the vertical gradient is not downward. The measurements and calculated gradients were:

Well Pair IDs	Date	Water Table Well Groundwater elevation (ft msl)	Deep Well Groundwater elevation (ft msl)	Elevation of Mid-point of water table well screen (ft msl)	Elevation of Mid-point of deep well screen (ft msl)	Vertical Gradient (positive is down, negative is up) (ft/ft)
MW-903S/ MW-903D	Dec 2005	578.19	578.23	578.2	550	-0.0014
MW-904S/ MW-904D	Dec 2005	584.06	584.07	577.1	549.8	-0.0004

Note: Elevations are referenced to feet above NGVD29 mean sea level datum (ft msl)

4.2.2 Hydraulic Conductivity Estimate

Hydraulic conductivity tests were conducted at each of the four monitoring wells installed around the Clark Landfill. Hydraulic conductivities were calculated utilizing the Bouwer and Rice (1976) analytical solution for unconfined aquifers. Field data was collected by inducing an instantaneous drawdown in the water level elevation with a disposable high density polyethylene (HDPE) bailer and measuring the water level recovery with a pressure transducer. A total of three individual tests were conducted at each well. Hydraulic conductivity values at each well were determined by calculating the geometric mean of the three tests at that location. A summary of hydraulic conductivity values is presented in Table 4-3.

As shown in Table 4-3, hydraulic conductivities in the slag-fill ranged from approximately 1.1×10^{-2} cm/sec to 3.8×10^{-1} cm/sec. Based on the results of the individual well tests the geometric mean of the fill in the vicinity of the wells at the Clark Landfill is approximately 1.2×10^{-1} cm/sec. These results are consistent with those expected for the slag-fill encountered during well installation.

5.0 Recommended Groundwater Monitoring Locations and Schedule

Three additional downgradient groundwater monitoring locations (MW-205S, MW-206S and MW-207S) are recommended to be installed pending IDEM approval based on an evaluation of the groundwater flow direction and current water budget conditions (Lake Michigan water levels and regional precipitation amounts). 329 IAC 10-15-5 (7) recommends two background and four downgradient monitoring wells as minimum monitoring requirements. The proposed monitoring locations and the rationale for the locations selected and a planned schedule for monitoring are described in more detail in Section 5.1 below.

5.1 Monitoring Well Locations and Rationale

Initially four monitoring wells (MW-201S, MW-202S, MW-203S and MW-204S) were installed along the perimeter of the landfill to document the hydrogeologic conditions (Figure 2-1). Based on the groundwater elevation data collected, monitoring wells MW-201S and MW-202S are upgradient wells located on the west and north sides of the landfill. MW-204S is located on the east side of the landfill adjacent to the intake flume. Well MW-204S also appears to be upgradient, or potentially side gradient of the landfill based on review of the groundwater elevation data as depicted in groundwater contour maps (see Figures 4-2 through 4-13).

Groundwater flow is from the west and north toward the intake flume. There is approximately 1,900 linear feet on the downgradient side of the landfill that is adjacent to the intake flume. Monitoring well MW-203S is currently the only downgradient well adjacent to the intake flume in this downgradient section. Thus, three additional downgradient wells (MW-205S, MW-206S and MW-207S) are being proposed to be located adjacent to the intake flume along the 1,900 foot downgradient portion of the site. As shown on Figure 5-1, these wells are proposed between MW-201S and MW-204S on either side of MW-203S.

The spacing of the proposed wells is approximately 300 to 350 feet apart on the downgradient section east of well MW-203S and about 475 feet west of well MW-203S. The 400 foot section immediately west of proposed well MW-207S is the area of the landfill that experienced the slump. This area was more heavily protected with a thicker layer of armor stone and surface cap material that was minimally compacted to avoid additional stress on this area. Thus, due to these conditions, a well through this area of the intake flume side of the landfill is not recommended or proposed.

5.2 Proposed Post-closure Groundwater Monitoring

5.2.1 First Year Sampling Schedule and Monitoring Parameters

Four quarterly groundwater sampling events will be conducted for the approved monitoring network (seven wells, MW-201S through MW-207S) to establish baseline water quality for the Phase I (329 IAC 10-29-6) and Phase II (329 IAC 10-29-7) constituents. The sampling will be conducted in accordance with the IDEM approved Groundwater Monitoring Plan (Appendix A). The analytes (IDEM Closure/Post Closure approval letter dated April 3, 2001) to be analyzed for baseline/background measurements will include:

- Phase I Detection monitoring parameters including:
 - field parameters (pH, specific conductance, temperature, and turbidity);

- laboratory parameters (boron, chloride, ammonia nitrogen, sodium, COD, total phenolics, methylene chloride, 1,1-dichloroethane, toluene, benzene, 1-2, dichloroethene, ethyl benzene and 2-butanone.
- Phase II Assessment monitoring parameters as indicated in 329 IAC 10-29-7(c) and 329 IAC 10-29-10(a) also will be monitored to establish background water quality values for these parameters.

Quarterly monitoring reports will be submitted to IDEM within 60 days of the sampling event. The data collected over the four quarter monitoring periods will be tabulated and statistically analyzed to establish background water quality standards. Background water quality values for the Phase I and Phase II constituents will be submitted to IDEM for review and approval following the completion of the four quarterly sampling events.

5.2.2 Second Year and Later Sampling Schedule

Following the first year collection of the background water quality data, the approved monitoring well network (seven wells, MW-201S through MW-207S) will be sampled semi-annually. The proposed monitoring schedule is:

<u>Sampling Round</u>	<u>Parameters to be Monitored</u>
1st - April/May	Phase I detection monitoring parameters 329 IAC 10-29-6
2nd - Oct/Nov	Phase I detection monitoring parameters 329 IAC 10-29-6

The semi-annual monitoring reports will be submitted to IDEM within 60 days of sampling during the post-closure monitoring period.

6.0 Qualifications

The purpose of this hydrogeologic conditions report is to define groundwater characteristics in the vicinity of the Clark Landfill. Factual information regarding operations, conditions, and test data were obtained, in part, from the client, outside agents and third parties and have been assumed by AECOM to be correct and complete. Because the facts stated in this report are subject to professional interpretation, they could result in differing conclusions. In addition, the findings and conclusions contained in this report are based on various quantitative factors as they existed on or near the date of the survey.

AECOM has prepared this report at the request of its client. AECOM assumes responsibility for the accuracy of the report's contents, subject to what is stated elsewhere in this section, but recommends the report be used only for the purpose intended by the client and AECOM when the report was prepared. The report may be unsuitable for other uses, and reliance on its contents by anyone other than the client is done at the sole risk of the user. AECOM accepts no responsibility for application or interpretation of the results by anyone other than the client.

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TABLE 2-1
DESCRIPTIONS OF SURFICIAL SOILS

Tawas Muck (0 to 1 percent slopes)

Included with in this soil in mapping are small areas where muck is less than 42 inches deep over clays, silts, or marl. Also, Included are areas where the surface layer contains silty material washed from eroded slopes. Other inclusions are area, where the overlying muck is thicker than 42 inches and areas where the underlying material is fine sandy loam.

A high water table is the major limitation. Runoff is very slow to ponded. A suitable drainage system is needed to remove excess water. This soil adapts well to a controlled drainage system. Tawas muck is subject to soil blowing if the surface layer dries and is unprotected by vegetative cover. Areas that are difficult to drain because of poor outlets are used for permanent pasture. If adequately drained, this soil can be farmed intensively to cultivated crops. The main crops grown are corn, soybeans, onions, carrots, and potatoes. (Capability unit IIIw-8)

Capability Unit IIIw-8

This unit consists of deep, very poorly drained, organic soils of the Carlisle, Linwood, and Tawas series. These soils are in depressional areas throughout the country. The mixed organic materials are 12 to 42 inch or more thick over coarse-textured, medium-textured, or moderately fine-textured mineral soil material or organic material.

The soils is this unit are very high in organic-mater content and have good tilth. Available moisture capacity is very high or moderate. Permeability in the organic layer is moderate and in the underlying material is very rapid to moderately slow. Surface runoff is very slow to ponded.

The major management concerns are wetness and soil blowing.

These soils are well suited to the crops commonly grown in the county. The main crops are corn and soybeans. Also grown are small grains, legume-grass mixtures and special crops. The special crops are mainly potatoes, onions, and carrots.

A drainage system is needed that provides open ditches for control of the water table. These ditches are supplemented by tile drains after the initial subsidence of the muck. The drainage system needed for the soil underlain by sand must include special blinding and filters over the tile to prevent clogging. This soil is well suited to practices that control the water table, but pumping may be required where a gravity outlet is not available. Diversion terraces are needed in many places to divert the surface runoff from the adjacent upland areas.

On these soils, proper use of crop residues, cover crops, and minimum tillage helps maintain the very high level of organic-matter content. These practices also aid in reducing soil blowing during spring. Many kinds of cropping systems are suitable of these soils including continuous use for row crops. Side dressings of fertilizer are needed.

Urban Land

Urban land (Ur.), mainly in the northern part of the county, is in and around communities and built-up areas. It consists of areas that have been filled with earth, cinders, basic slag, trash, or any combination of these, and that then have been smoothed over. The surface layer and subsoil have been removed or have been disturbed so much that the soil can no longer be identified. Urban land also includes those areas where sand dunes have been removed and the areas leveled. (Capability unit VIIIa-1)

Capability Unit VIIIa-1

Lake beaches are along the southern shores of Lake Michigan in the northern part of the county. They are used for harbors and industrial developments. These areas are well suited to use for recreation.

Urban land consists of areas where the surface layer and subsoil have been removed or have been disturbed so much that the soil can no longer be identified. Most of this land is in and around communities and built-up areas.

Table 4-1
Clark Landfill Groundwater Measurements and Elevations

Well Number & Data		MW-201S			MW-202S		MW-203S		MW-204S		West End of Intake Flume SW-201	
Ground Surface Elevation (ft msl)		598.2			601.0		585.1		597.3		597.94	
Top of PVC Casing Elevation (ft)		600.41			603.48		587.86		599.82		---	
Well Depth (Feet from TOC) ^A		28.00			31.00		18.00		26.00			
Date		Depth to LNAPL from TOC (ft)	Depth to GW from TOC (ft)	Groundwater Elevation (ft msl)	Depth to GW from TOC (ft)	Groundwater Elevation (ft msl)	Depth to GW from TOC (ft)	Groundwater Elevation (ft msl)	Depth to GW from TOC (ft)	Groundwater Elevation (ft msl)	Depth from MP* (ft)	Water Elevation (ft msl)
After Development		--	20.48	579.93	24	579.48	8.66	579.20	20.48	579.34		
2-Mar-10		--	20.26	580.15	24.11	579.37	8.91	578.95	20.48	579.34		
9-Mar-10		--	20.50	579.91	24.4	579.08	9.19	578.67	20.75	579.07		
16-Mar-10		--	20.31	580.10	24.18	579.30	9.06	578.80	20.56	579.26		
22-Mar-10		--	20.22	580.19	24.02	579.46	8.62	579.24	20.35	579.47	19.59	578.35
30-Mar-10		--	20.40	580.01	24.37	579.11	9.47	578.39	20.75	579.07	20.17	577.77
12-Apr-10		--	20.39	580.02	24.26	579.22	8.91	578.95	20.61	579.21	19.79	578.15
4-May-10		--	21.52	578.89	24.42	579.06	9.25	578.61	20.78	579.04	20.21	577.73
9-Jun-10		--	20.23	580.18	24.06	579.42	8.95	578.91	20.46	579.36		
28-Jul-10		--	19.92	580.49	23.86	579.62	8.64	579.22	20.28	579.54	19.85	578.09
30-Aug-10		--	20.10	580.31	23.98	579.50	8.86	579.00	20.38	579.44	19.96	577.98
28-Oct-10		--	21.47	578.94	25.44	578.04	10.00	577.86	21.78	578.04		
25-Jan-11		--	21.27	579.14	25.32	578.16	10.04	577.82	21.73	578.09	21	576.94
24-Feb-11		--	21.23	579.18	25.29	578.19	10.15	577.71	21.7	578.12	21.49	576.45
28-Mar-11		--	20.88	579.53	24.87	578.61	9.70	578.16	21.31	578.51	20.79	577.15
3-May-11		--	20.61	579.80	24.42	579.06	9.24	578.62	20.80	579.02	20.21	577.73
27-May-11		--	19.96	580.45	23.53	579.95	8.56	579.30	19.97	579.85	19.75	578.19
27-Jun-11		--	20.23	580.18	23.92	579.56	8.39	579.47	20.27	579.55	19.46	578.48
22-Jul-11		--	20.28	580.13	24.07	579.41	8.76	579.10	20.44	579.38	19.76	578.18
31-Aug-11		--	20.28	580.13	24.13	579.35	8.92	578.94	20.56	579.26	20.00	577.94
30-Sep-11		--	19.97	580.44	23.45	580.03	7.73	580.13	19.72	580.10	18.78	579.16
7-Nov-11		--	20.60	579.81	24.67	578.81	9.38	578.48	21.05	578.77	20.58	577.36
5-Dec-11		--	20.58	579.83	24.44	579.04	8.93	578.93	20.74	579.08	19.90	578.04
22-Dec-11		--	20.65	579.76	24.61	578.87	9.16	578.70	20.96	578.86	20.00	577.94
27-Jan-12		--	20.66	579.75	24.64	578.84	9.29	578.57	20.99	578.83	20.43	577.51
1-Mar-12		--	20.67	579.74	24.6	578.88	9.19	578.67	20.93	578.89	20.31	577.63
13-Mar-12		--	20.85	579.56	24.84	578.64	9.43	578.43	21.18	578.64	20.45	577.49
24-Apr-12		--	20.55	579.86	24.5	578.98	9.45	578.41	20.91	578.91	20.51	577.43
31-May-12		--	20.51	579.90	24.38	579.10	8.98	578.88	20.70	579.12	19.85	578.09
26-Jun-12		--	20.04	580.37	24.18	579.30	9.10	578.76	20.58	579.24	20.31	577.63
24-Jul-12		--	20.37	580.04	24.47	579.01	9.19	578.67	20.87	578.95	20.45	577.49
End												

Notes:

ft msl = Elevation referenced to feet above mean sea level using the National Geodetic Vertical Datum of 1929 (NGVD29)

TOC = Top of PVC Casing

^A = as measured inside well

ft = feet

NI = Not Installed

-- No Elevation or thickness

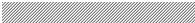
 = Not measured, no elevation

Table 4-2
Summary of Calculated Horizontal Gradients and Linear Velocity
Clark Landfill, East Chicago, IN
Project No. 60157813

Wells		Results			Calculation Data					
From Well (# 1)	To Well (# 2)	Gradient (feet per foot)	Linear Velocity ^A (feet/year)	Hydrogeologic Unit	Hydraulic Conductivity (cm/sec) ^B	Distance between wells (feet)	GW Elevation Well #1 (msl) ^C	GW Elevation Well #2 (msl) ^C	Effective Porosity ^D	Date of Groundwater Measurement
MW-201S	MW-203S	0.0008	1220	Slag-fill	1.19E-01	1340	580.02	578.95	0.25	April 2010
		0.0010	1493	Slag-fill	1.19E-01	1340	580.31	579.00	0.25	August 2010
		0.0008	1231	Slag-fill	1.19E-01	1340	578.94	577.86	0.25	October 2010
		0.0010	1505	Slag-fill	1.19E-01	1340	579.14	277.82	0.25	January 2011
		0.0009	1345	Slag-fill	1.19E-01	1340	579.80	578.62	0.25	May 2011
		0.0009	1299	Slag-fill	1.19E-01	1340	580.44	579.30	0.25	September 2011
		0.0010	1516	Slag-fill	1.19E-01	1340	579.81	578.48	0.25	November 2011
		0.0009	1345	Slag-fill	1.19E-01	1340	579.75	578.57	0.25	January 2012
		0.0076	1163	Slag-fill	1.19E-01	1340	579.90	578.88	0.25	May 2012
	Average	0.0016	1346							
MW-202S	MW-203S	0.0003	53	Slag-fill	2.01E-01	950	579.22	578.95	0.25	April 2010
		0.0005	437	Slag-fill	2.01E-01	950	579.50	579.00	0.25	August 2010
		0.0002	157	Slag-fill	2.01E-01	950	578.04	577.86	0.25	October 2010
		0.0004	297	Slag-fill	2.01E-01	950	578.16	577.82	0.25	January 2011
		0.0005	384	Slag-fill	2.01E-01	950	579.06	578.62	0.25	May 2011
		-0.0001	-87	Slag-fill	2.01E-01	950	580.03	580.13	0.25	September 2011
		0.0004	288	Slag-fill	2.01E-01	950	578.81	578.48	0.25	November 2011
		0.0003	236	Slag-fill	2.01E-01	950	578.84	578.57	0.25	January 2012
		0.0002	192	Slag-fill	2.01E-01	950	579.10	578.88	0.25	May 2012
	Average	0.0003	217							

Notes:

^A Linear velocity represents the average rate at which water moves between two points: $V=Ki/\eta$, where V= linear velocity (ft/yr), K=hydraulic conductivity, i=gradient and η =effective porosity. Rounded to two significant figures.

^B Hydraulic conductivity values listed are the geometric mean from the Hydraulic Conductivity Summary Table

^C Groundwater elevations calculated from water level measurements and shown as feet above NGVD29 mean sea level.

^D Effective porosity values estimated from soil textures listed in *Groundwater* by Freeze and Cherry (1979)

Table 4-3
Summary of In-Situ Hydraulic Conductivity Testing Results

Clark Landfill - ArcelorMittal, Indiana Harbor
Whiting, IN - AECOM Project #60157812.1

Well Identification	Hydraulic Conductivity				Screened Lithologic Unit	Solution Method
	Test 1	Test 2	Test 3	Geometric Mean		
	(cm/sec)					
MW-201S	2.5E-01	3.8E-01	1.9E-01	2.6E-01	Slag Fill	Bouwer-Rice (Unconfined)
MW-202S	9.5E-02	9.5E-02	9.5E-02	9.5E-02	Slag Fill	Bouwer-Rice (Unconfined)
MW-203S	1.8E-01	2.3E-01	2.3E-01	2.1E-01	Slag Fill	Bouwer-Rice (Unconfined)
MW-204S	9.7E-02	1.1E-02	5.0E-02	3.8E-02	Slag Fill	Bouwer-Rice (Unconfined)

Summary Statistics per Hydrostatic Unit (cm/sec.)

Hydrostatic Unit:	No. of Tests:	Minimum:	Maximum:	Geometric Mean:
Slag Fill	12	1.1E-02	3.8E-01	1.2E-01

Notes:

"n/a" indicates not applicable or that additional tests were not conducted at well.

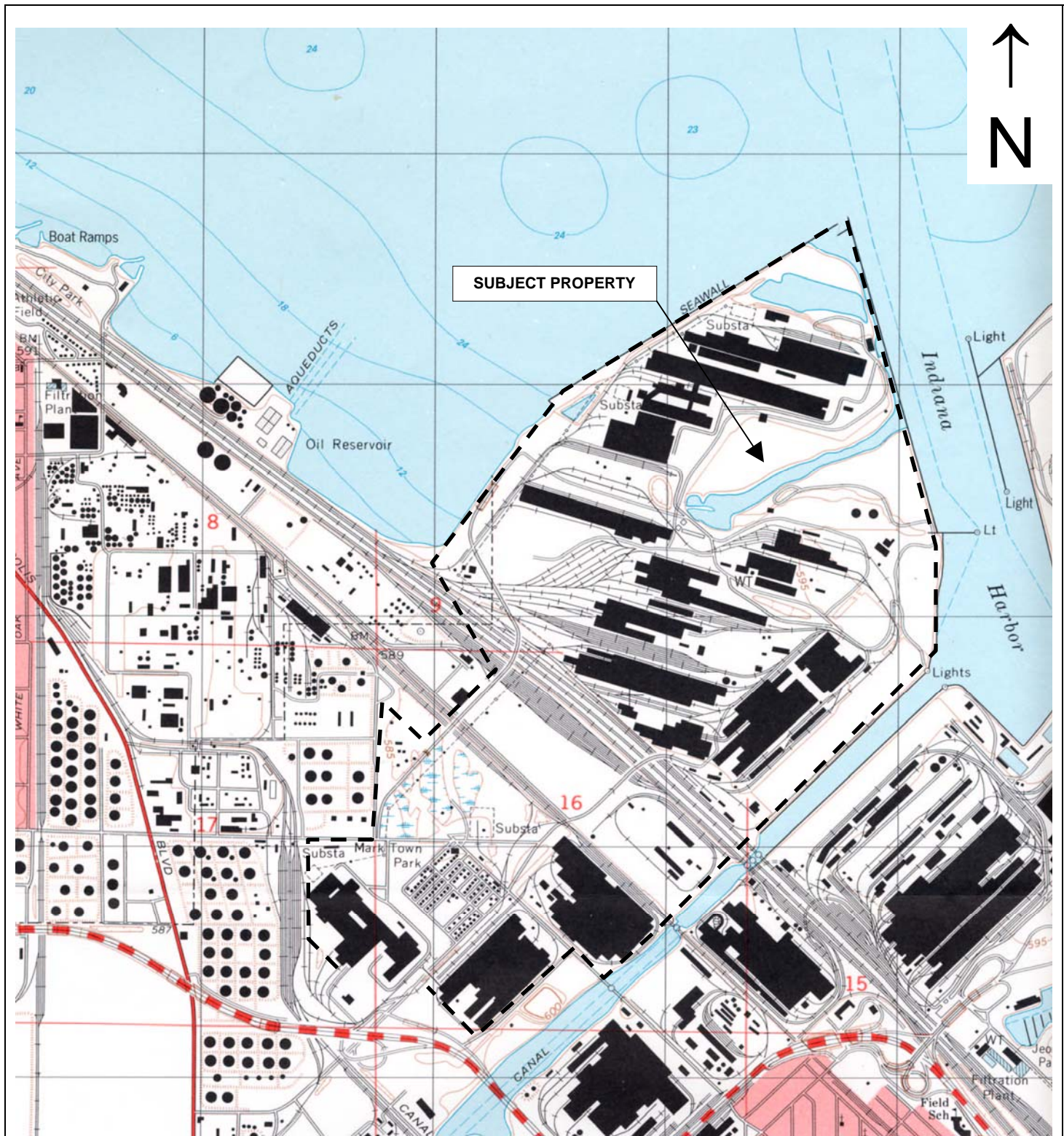
Kv/Kh anisotropy ratio assumed to be 1.0

References:

1. Bouwer, H., 1989. The Bouwer and Rice slug test--an update, Ground Water, vol. 27, no. 3, pp. 304-309.
2. Bouwer, H. and R.C. Rice, 1976. A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resour. Res., vol. 12, no. 3, pp. 423-428.

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Figure 4-14	Well Pair Locations
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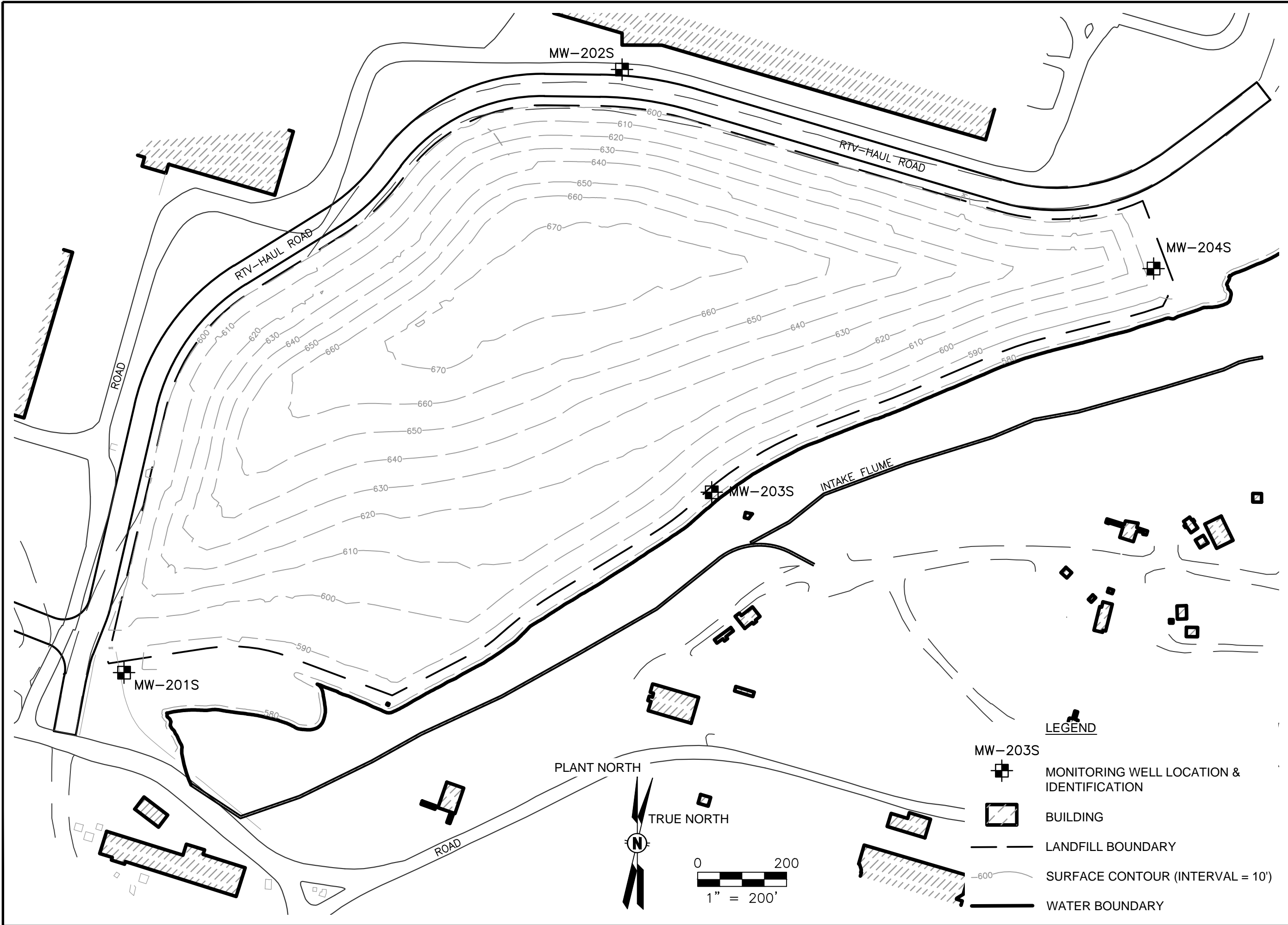
Source: USGS 7.5 Minute Topographic Map, Whiting, IN 1998

AECOM

SITE LOCATION
CLARK LANDFILL
ARCELORMITTAL INDIANA HARBOR
EAST CHICAGO, INDIANA

DRAWN BY: GMB	DATE: 6-8-11
CHECKED BY: LLA	DATE: 6-8-11
APPROVED BY: SCK	DATE: 6-8-11
FILE NO.: Clark-topo	SCALE : 1:24000
PROJECT NO. 60157813	FIGURE NO. 1-1

P:\12084-ArcelorMittal\60157813-Clark_Monitoring-2011-12\7.0 Deliverables\Cadd\G60157738-BASE.dwg; 8/13/2012 12:18:59 PM; ENGELHARDT, SARAH; STS.stb



11425 West Lake Park Drive
Milwaukee, WI 53224
414.359.3030
www.aecom.com
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SITE LAYOUT
CLARK LANDFILL
ARCELORMITTAL INDIANA HARBOR LLC. (WEST)
EAST CHICAGO, INDIANA

LEGEND

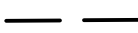
MW-203S



MONITORING WELL LOCATION &
IDENTIFICATION



BUILDING



LANDFILL BOUNDARY



SURFACE CONTOUR (INTERVAL = 10')

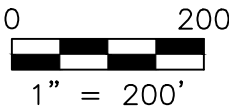


WATER BOUNDARY

PLANT NORTH



TRUE NORTH



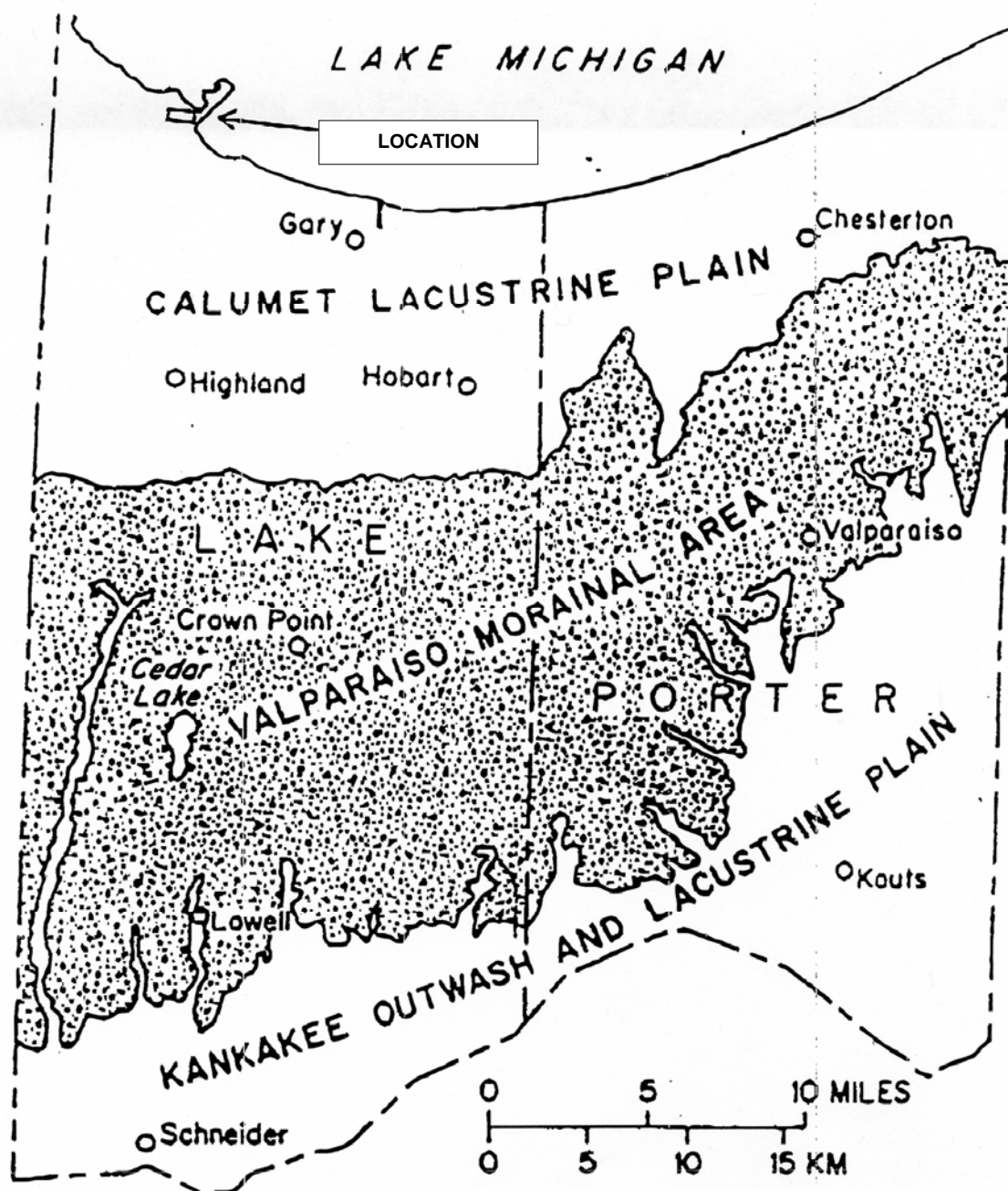
Drawn : SAP 8/13/2012

Checked: LLA 8/13/2012

Approved: LLA 8/13/2012

PROJECT
NUMBER 60157813

FIGURE
NUMBER 2-1



LOCATIONS OF PHYSIOGRAPHIC REGIONS
LAKE AND PORTER COUNTIES, INDIANA

(after Hartke, Hill and Reshkin, 1975)

DRAWN BY: GMB

DATE: 1/20/2006

CHECKED BY: LLA

DATE: 1/20/2006

APPROVED BY: JMT

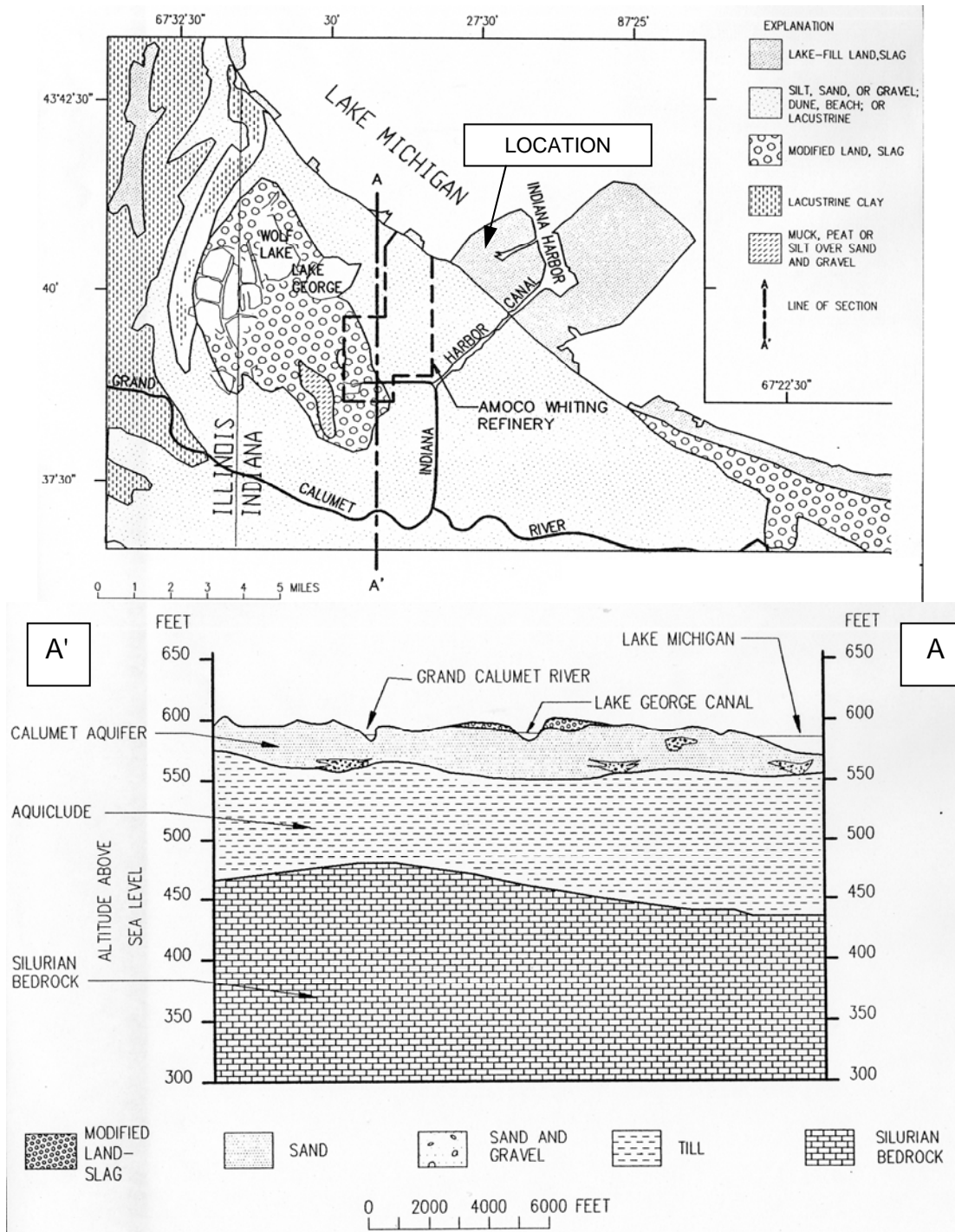
DATE: 1/20/2006

FILE NO.: FIG 2-2.doc

SCALE:
AS SHOWN

PROJECT NO.
60157813

FIGURE NO.
2-2



AECOM

**SURFICIAL GEOLOGY MAP AND GEOLOGIC
CROSS SECTION
NORTHWEST INDIANA**

(Modified after Watson, 1988)

DRAWN BY: GMB

DATE: 1/20/2006

CHECKED BY: LLA

DATE: 1/20/2006

APPROVED BY: JMT

DATE: 1/20/2006

FILE NO.: FIG 2-4.doc

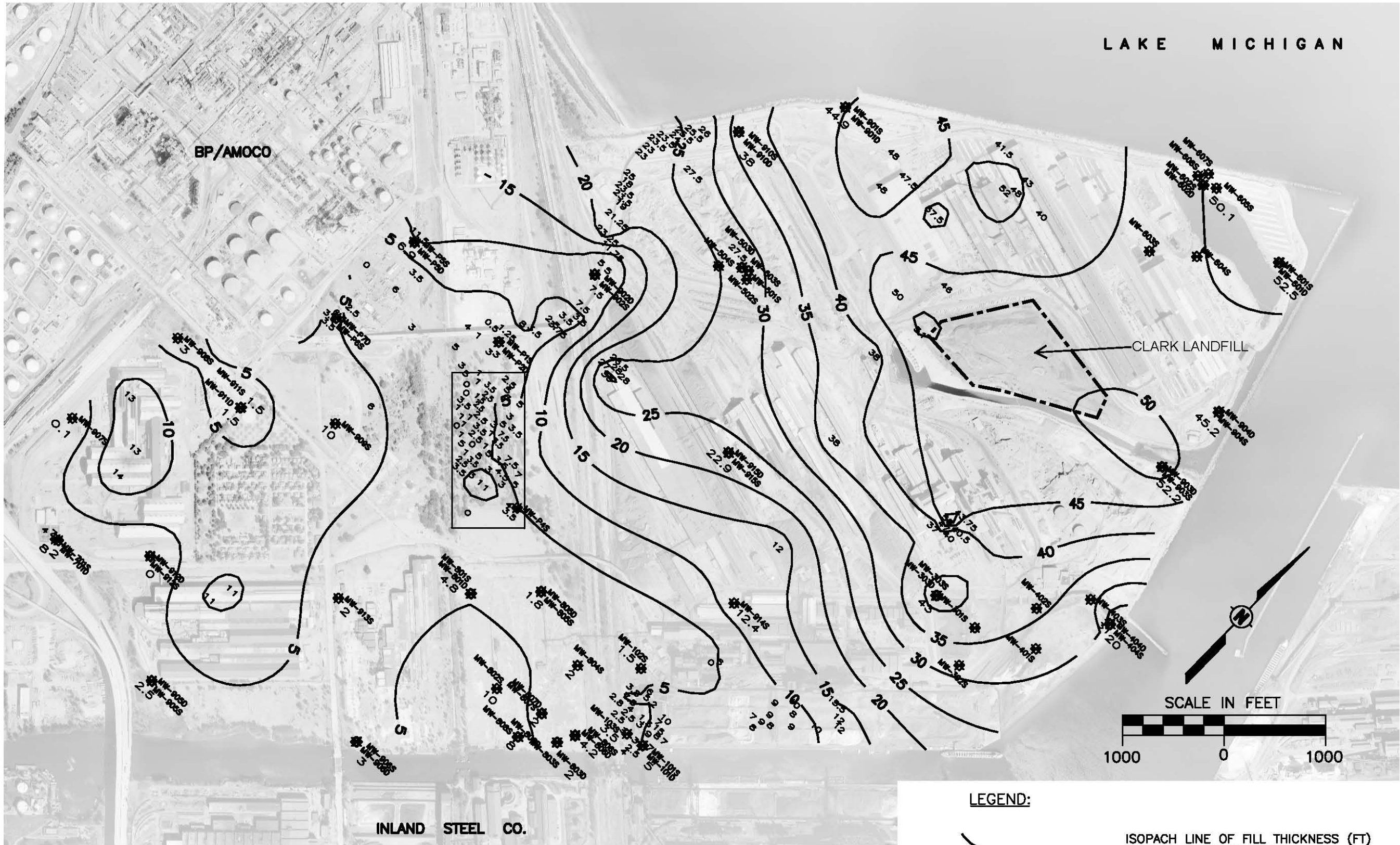
SCALE:
AS SHOWN

PROJECT NO.

60157813

FIGURE NO.

2-3



NOTE:
FILL THICKNESSES HAVE BEEN INTERPOLATED FROM DATA OBTAINED AT BORING LOCATIONS. ACTUAL SUBSURFACE CONDITIONS MAY VARY IN-SITU.

FOR BORINGS WITH GROUND SURFACE ELEVATIONS GREATER THAN 595 FT MSL, FILL ISOPACHS HAVE BEEN NORMALIZED TO MINIMIZE THE EFFECTS OF SURFACE TOPOGRAPHY (i.e. THE THICKNESS OF THE CLARK LANDFILL, THE HILL, etc.).

OUTLINED REGIONS CONTAIN ONLY A REPRESENTATIVE SAMPLE OF DATA POINTS BECAUSE OF THE NUMEROUS BORING LOGS AVAILABLE.

LEGEND:

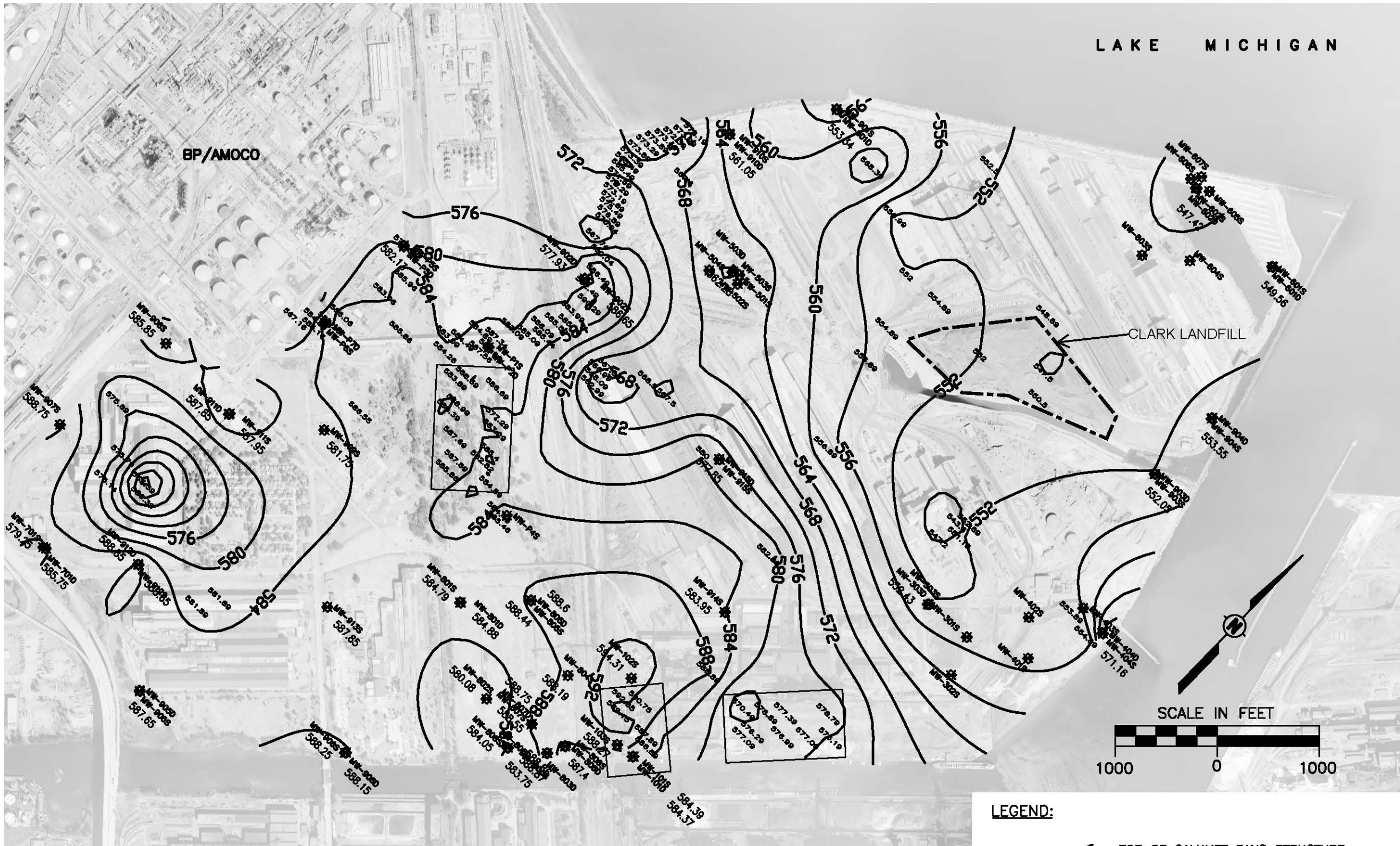
— 25 — ISOPACH LINE OF FILL THICKNESS (FT)
DASHED WHERE INFERRED
(5-FT INTERVAL)

★ MW-914S 12.4 THICKNESS OF SLAG FILL (FEET):
STS MONITORING WELL LOCATIONS

● PREVIOUSLY EXISTING BORING LOCATIONS

SLAG-FILL ISOPACH
CLARK LANDFILL HYDROGEOLOGIC STUDY REPORT
ARCELORMITTAL INDIANA HARBOR
EAST CHICAGO, INDIANA


Drawn:	gmb	02/22/2006
Checked:	sck	02/28/2006
Approved:	jmt	02/28/2006
PROJECT NUMBER	60157813	
FIGURE NUMBER	2-4	

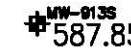



NOTE:
TOP OF CALUMET SAND ELEVATIONS HAVE BEEN INTERPOLATED FROM DATA OBTAINED AT BORING LOCATIONS. ACTUAL SUBSURFACE CONDITIONS MAY VARY IN-SITU.

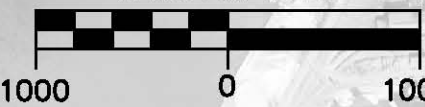
OUTLINED REGIONS CONTAIN ONLY A REPRESENTATIVE SAMPLE OF DATA POINTS BECAUSE OF THE NUMEROUS BORING LOGS AVAILABLE.

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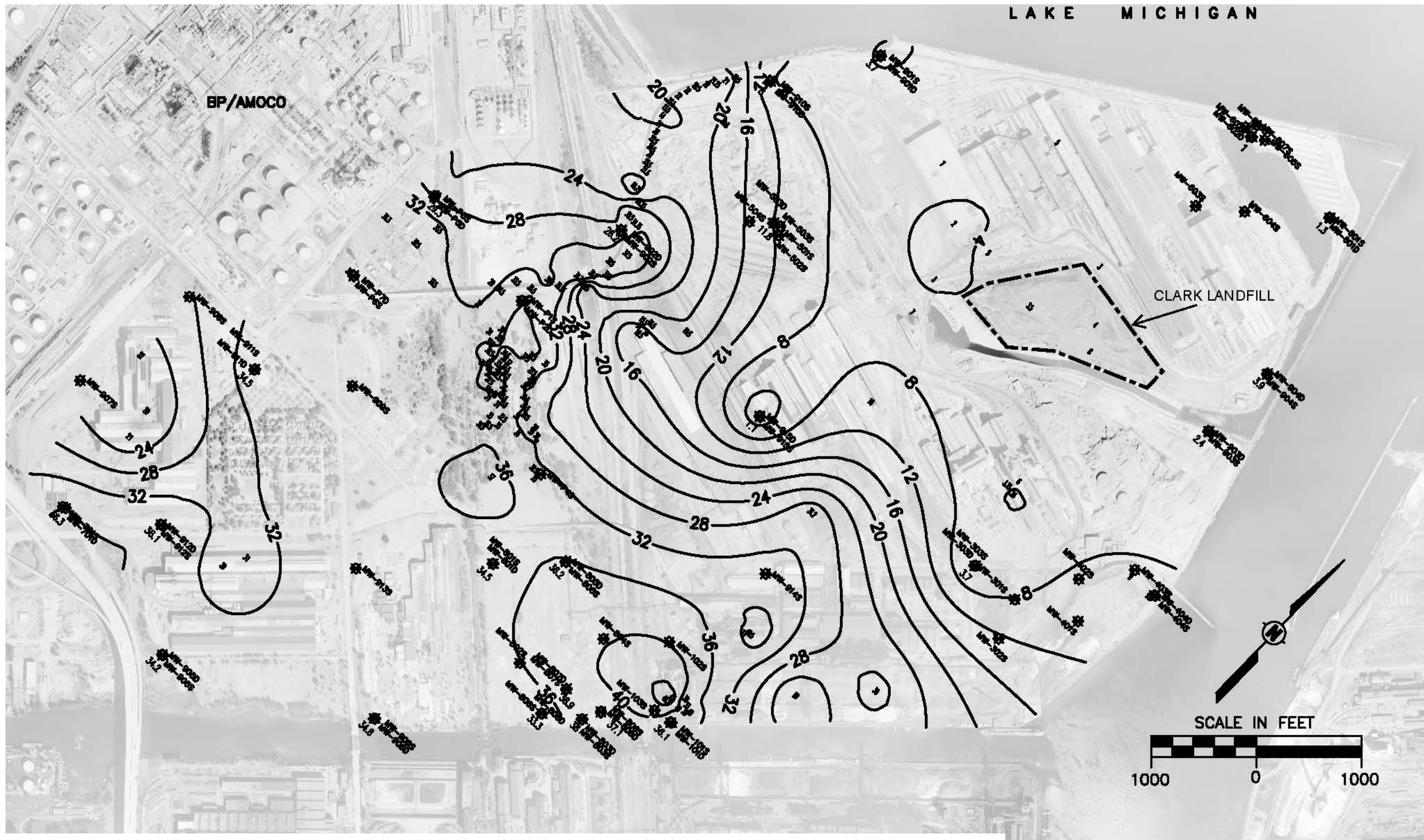
 **572** TOP OF CALUMET SAND STRUCTURE CONTOUR LINE (FT MSL)
DASHED WHERE INFERRED (2-FT INTERVAL)

 **MW-0135**
587.85 TOP OF CALUMET SAND SPOT ELEVATION (FT MSL)

 **568.5** PREVIOUSLY EXISTING BORING LOCATIONS

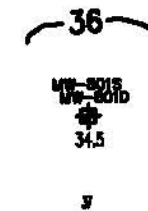
 SCALE IN FEET
1000 0 1000

60157813-Fig_2-6-Calumet_sand_isopach.docx



NOTES:
CALUMET SAND THICKNESSES HAVE BEEN INTERPOLATED FROM DATA OBTAINED AT BORING LOCATIONS. ACTUAL SUBSURFACE CONDITIONS MAY VARY IN-SITU DUE TO LITHOLOGICAL FACIES CHANGES.

LEGEND:



CALUMET SAND ISOPACH LINE (FT)
DASHED WHERE INFERRED
(2-FT INTERVAL)

SPOT THICKNESS OF CALUMET SAND (FEET):
STS MONITORING WELL LOCATIONS

PREVIOUSLY EXISTING BORING LOCATIONS

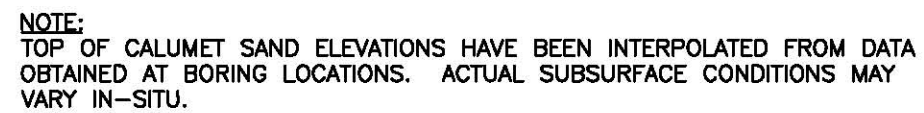


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CALUMET SAND ISOPACH
CLARK LANDFILL HYDROGEOLOGIC STUDY REPORT
ARCELORMITTAL INDIANA HARBOR
EAST CHICAGO, INDIANA

Drawn:	gmb
Checked:	sck 02/28/2006
Approved:	jmt 02/28/2006
PROJECT NUMBER	60157813
FIGURE NUMBER	2-6

STRUCTURE CONTOUR – TOP OF CLAY
CLARK LANDFILL HYDROGEOLOGIC STUDY REPORT
ARCELOMITTAL INDIANA HARBOR
EAST CHICAGO, INDIANA



OUTLINED REGIONS CONTAIN ONLY A REPRESENTATIVE SAMPLE OF DATA
POINTS BECAUSE OF THE NUMEROUS BORING LOGS AVAILABLE.

LEGEND:

— 552 —

MW-902D
MW-902S
551.73

594

TOP OF CLAY ELEVATION STRUCTURE
CONTOUR LINE (FT MSL)
DASHED WHERE INFERRED
(2-FT INTERVAL)

TOP OF CLAY SPOT ELEVATION (FEET):
STS MONITORING WELL LOCATIONS

PREVIOUSLY EXISTING BORING LOCATIONS

Drawn: gmb

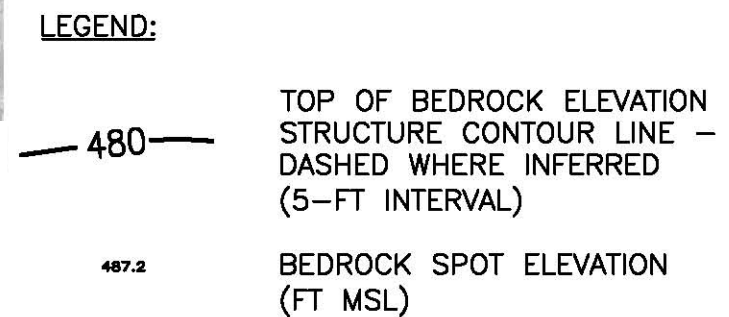
Checked: sck 02/28/2006

Approved: jmt 02/28/2006

PROJECT
NUMBER 60157813

FIGURE NUMBER 2-7

STRUCTURE CONTOUR – TOP OF ROCK
CLARK LANDFILL HYDROGEOLOGIC STUDY REPORT
ARCELOMITTAL INDIANA HARBOR
EAST CHICAGO, INDIANA



NOTE:
TOP OF BEDROCK ELEVATIONS HAVE BEEN INTERPOLATED FROM DATA OBTAINED AT BORING LOCATIONS. ACTUAL SUBSURFACE CONDITIONS MAY VARY IN-SITU. SOME FLUCTUATIONS IN TOP OF BEDROCK ELEVATIONS MAY OCCUR BETWEEN BORINGS BECAUSE OF EROSIONAL SURFACES AND DIFFICULTY DIFFERENTIATING HARDPAN, RUBBLE AND THE UPPER WEATHERED PORTION OF BEDROCK.

Drawn:	gmb	
Checked:	sck	02/28/2006
Approved:	jmt	02/28/2006
PROJECT NUMBER	60157813	
FIGURE NUMBER	2-8	

SYSTEM	STRATIGRAPHIC UNITS		DOMINANT LITHOLOGY	THICKNESS IN FEET
QUATERNARY	Glacial drift		Sand, gravel, and clay	55 - 210
DEVONIAN	Antrim Shale		Shale	0 - 135
	Traverse Fm.		Limestone	0 - 135
SILURIAN	Detroit River Fm. Salina Fm. Wabash Fm. Louisville Ls. Salamonie Dol. Brossfield Ls.		Dolomite and limestone	380 - 555
ORDOVICIAN	Maquoketa Gr.		Shale and limestone	170 - 285
	Trenton Ls. Black River Ls.		Limestone and dolomite	320 - 370
	St. Peter Ss.		Sandstone	30 - 325
	Knox Dol.		Dolomite	65 - 625
CAMBRIAN	Galesville Ss.		Sandstone and dolomite Sandstone	65 - 150 165 - 215
	Eau Claire Fm.		Shale, dolomite, and sandstone	540 - 620
	"B" cap		Shale	
	Mount Simon Ss.		Sandstone	1,600 - 2,000
PRE-CAMBRIAN			Granite	



BEDROCK GEOLOGY
STRATIGRAPHIC COLUMN

(after Hartke, Hill and Reshkin, 1975)

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DATE: 1/20/2006

CHECKED BY: LLA

DATE: 1/20/2006

APPROVED BY: JMT

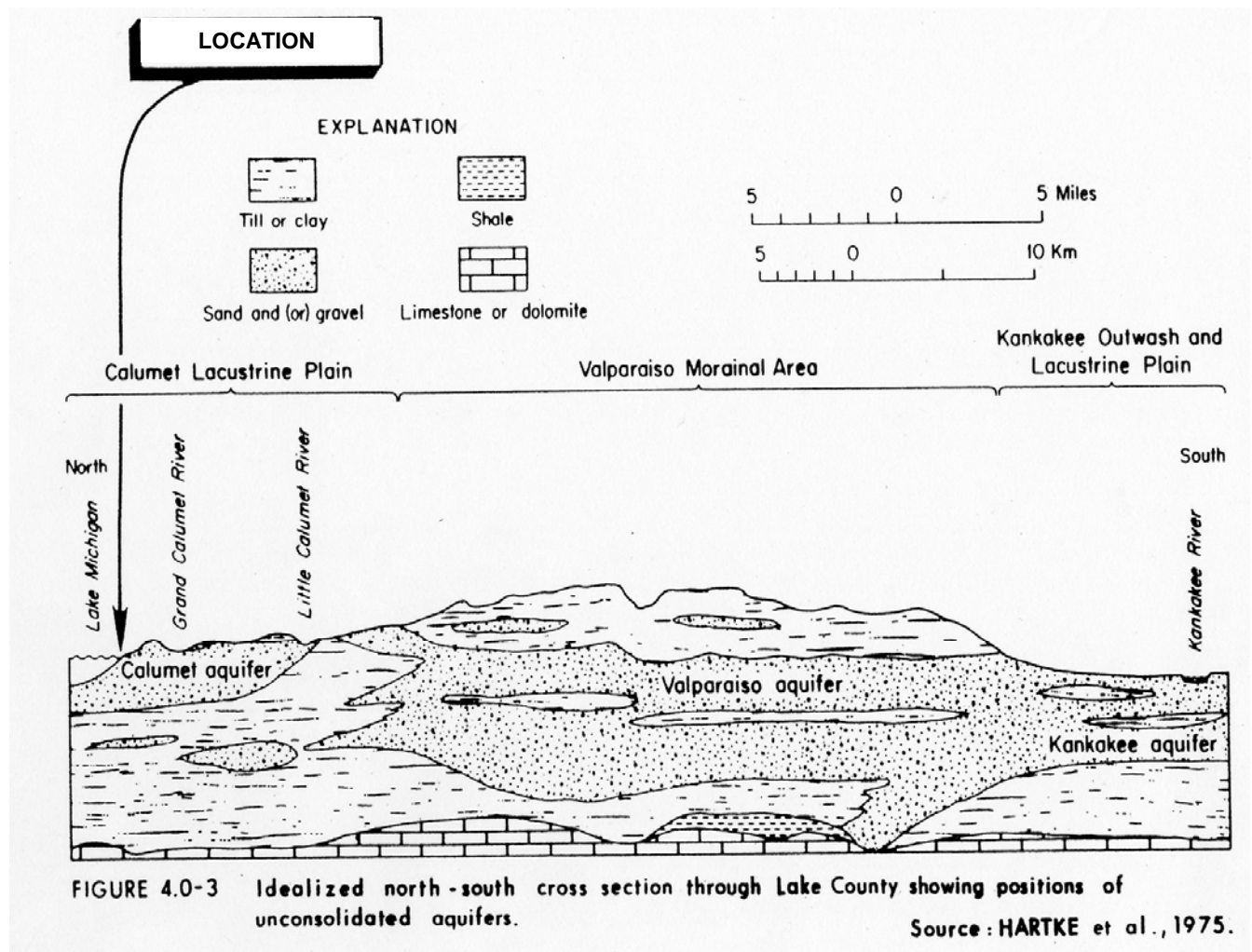
DATE: 1/20/2006

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SCALE:
NTS

PROJECT NO.
60157813

FIGURE NO.
2-9



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IDEALIZED NORTH-SOUTH CROSS
SECTION THROUGH LAKE COUNTY
SHOWING POSITIONS OF
UNCONSOLIDATED AQUIFERS

(after Hartke, Hill and Reshkin, 1975)

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DATE: 1/20/2006

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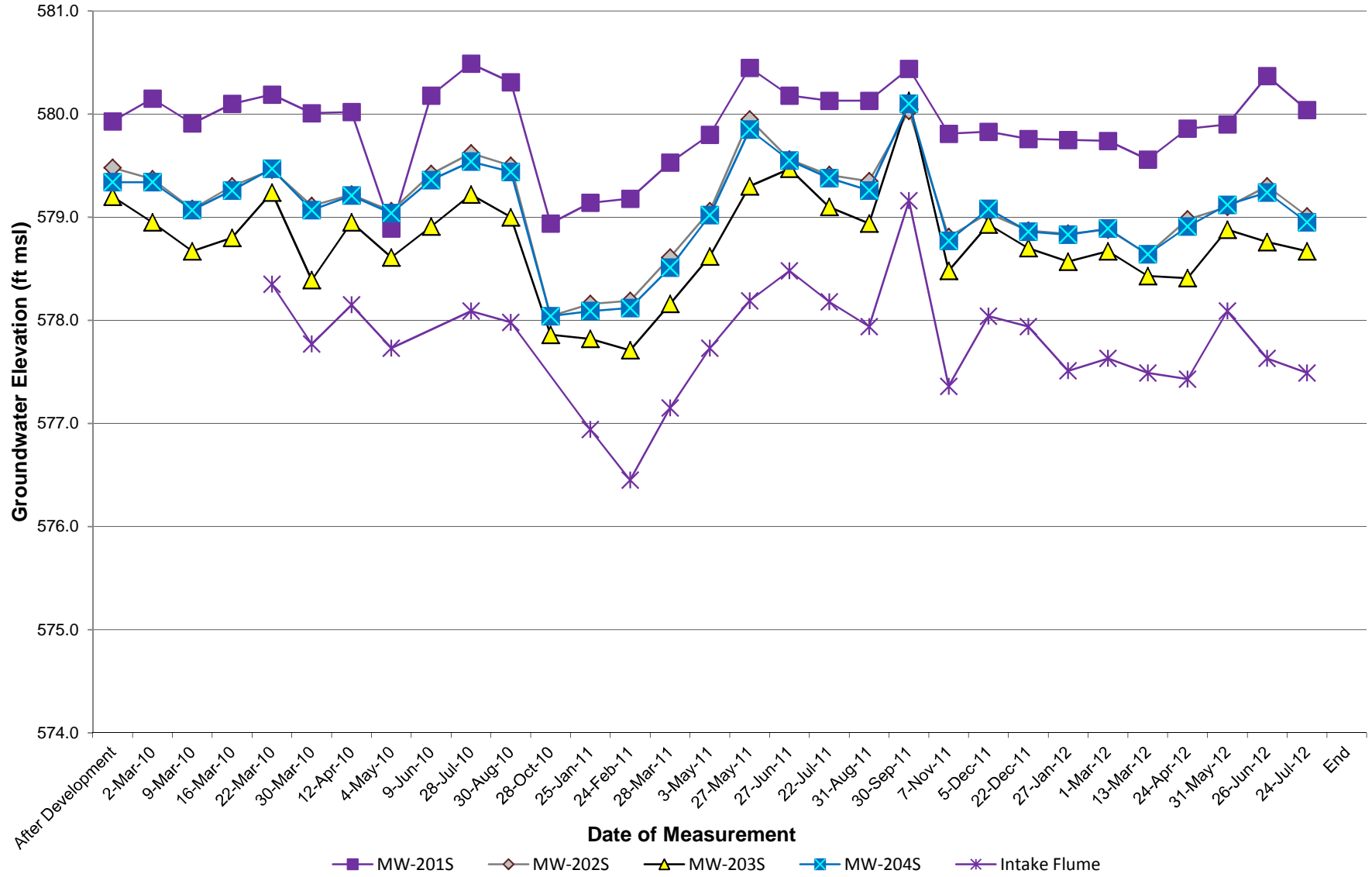
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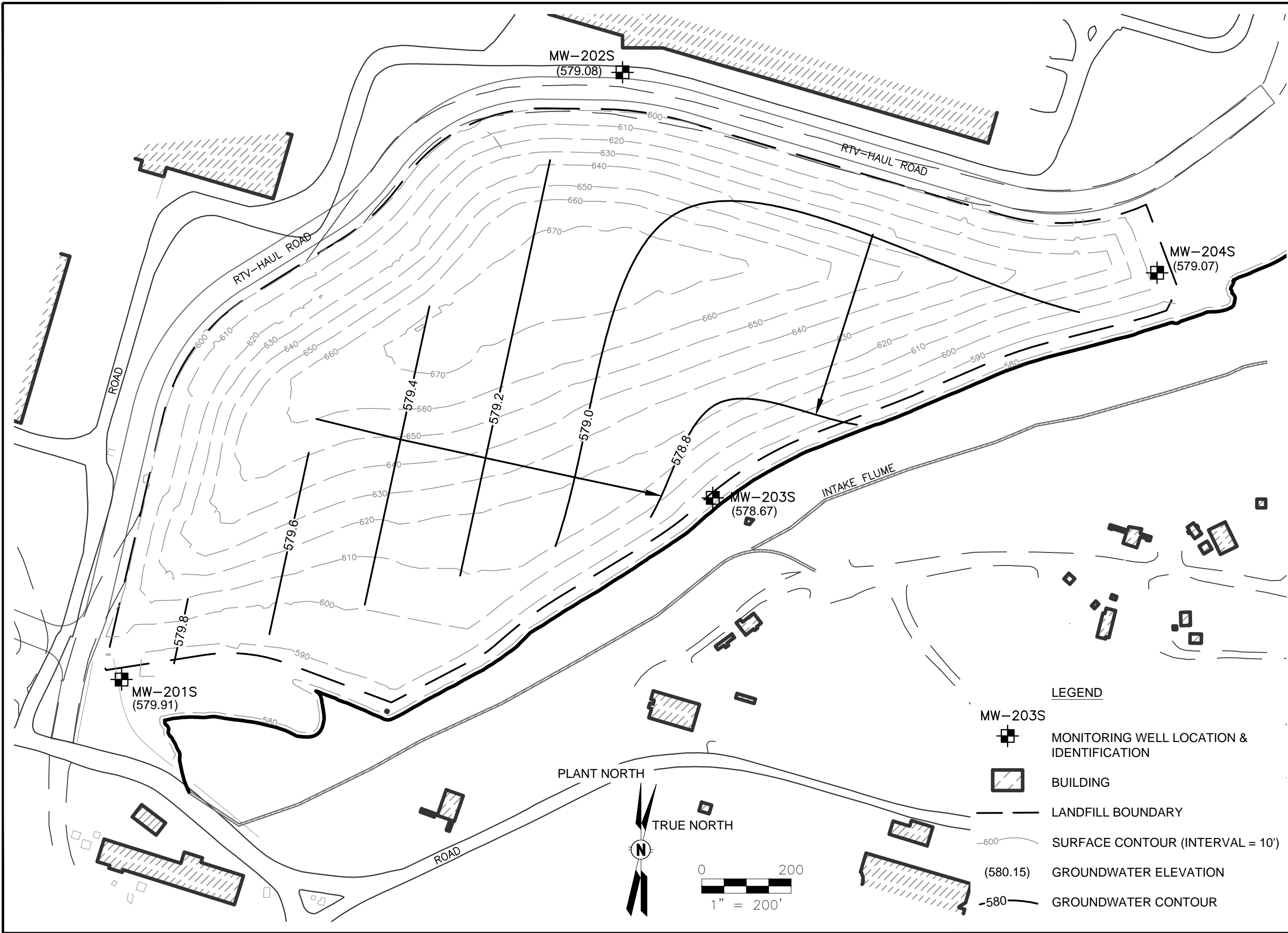
PROJECT NO.
60157813

FIGURE NO.
2-10

Figure 4-1
Group B- Groundwater Elevation
ISG Indiana Harbor / Tecumseh Redevelopment Inc.



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GROUNDWATER CONTOUR MAP MARCH 9, 2010

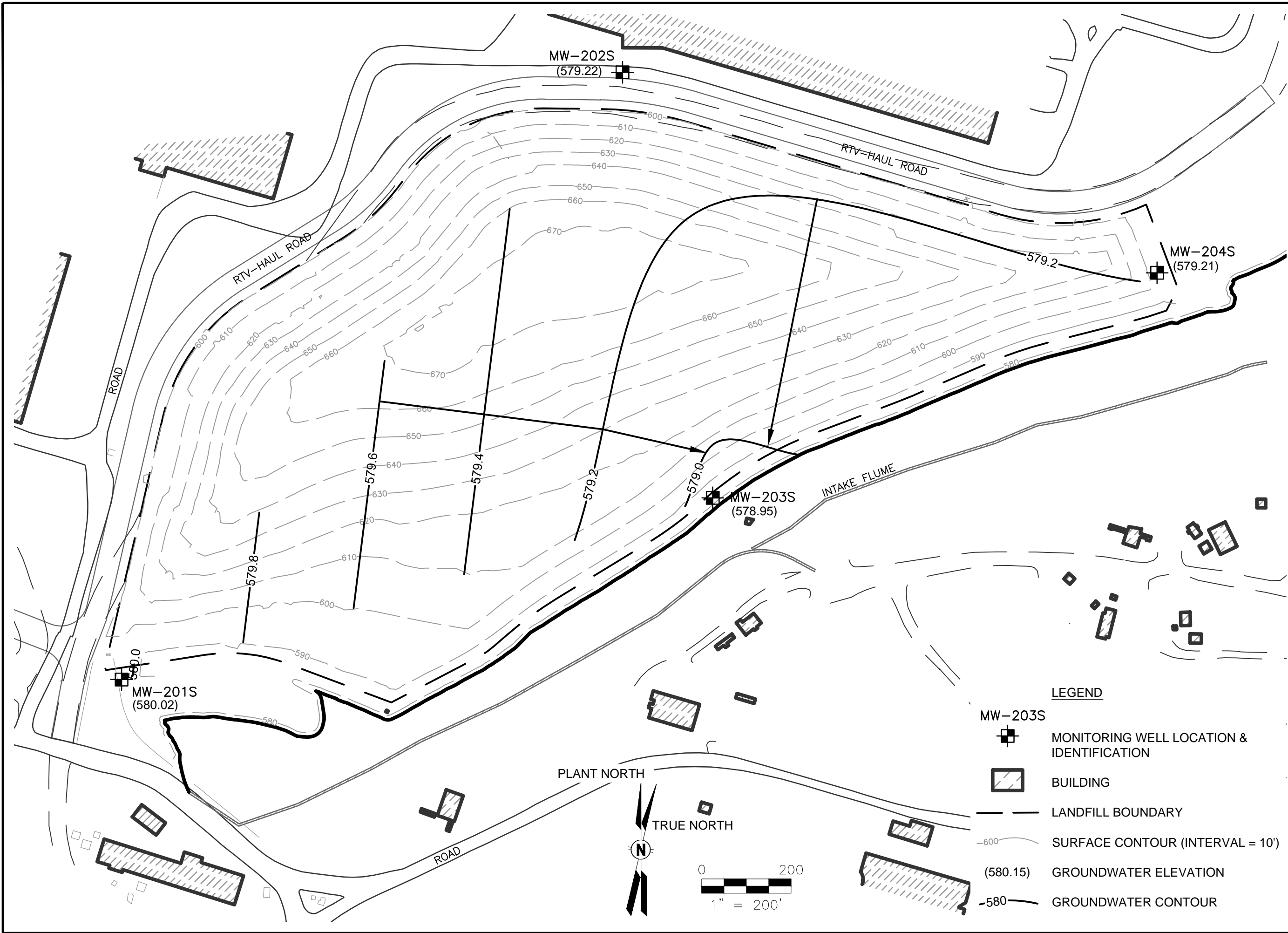
CLARK LANDFILL
ARCELORMITTAL INDIANA HARBOR LLC.(WEST)
EAST CHICAGO, INDIANA

LEGEND

- MW-203S
MONITORING WELL LOCATION & IDENTIFICATION
- BUILDING
- LANDFILL BOUNDARY
- SURFACE CONTOUR (INTERVAL = 10')
- (580.15) GROUNDWATER ELEVATION
- GROUNDWATER CONTOUR

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Approved:	LLA	8/13/2012
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FIGURE NUMBER	4-2	

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- LEGEND**
- MW-203S
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 - [Hatched rectangle symbol] BUILDING
 - [Thick solid line symbol] LANDFILL BOUNDARY
 - [Dashed line symbol] SURFACE CONTOUR (INTERVAL = 10')
 - (580.15) GROUNDWATER ELEVATION
 - 580- GROUNDWATER CONTOUR



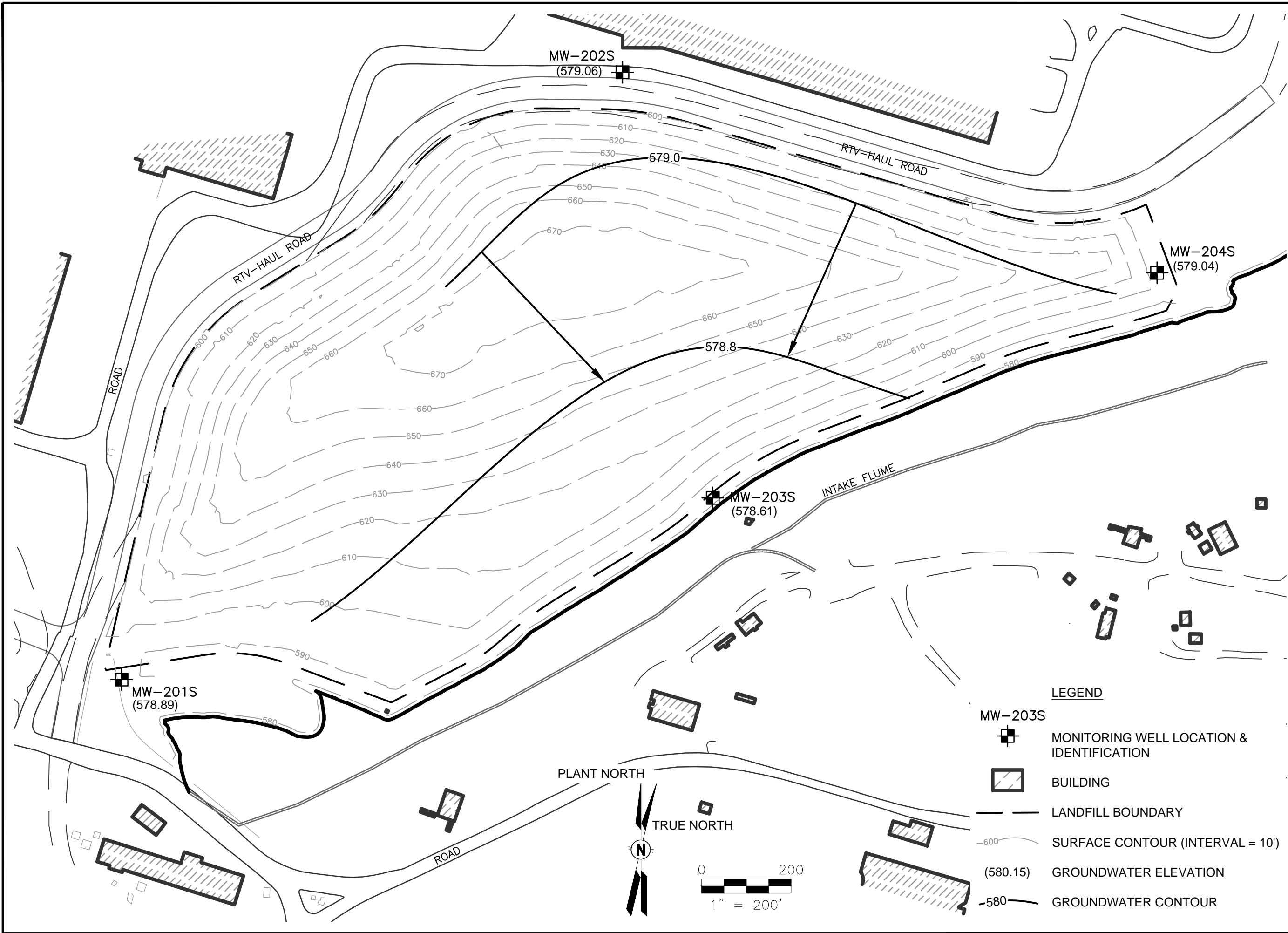
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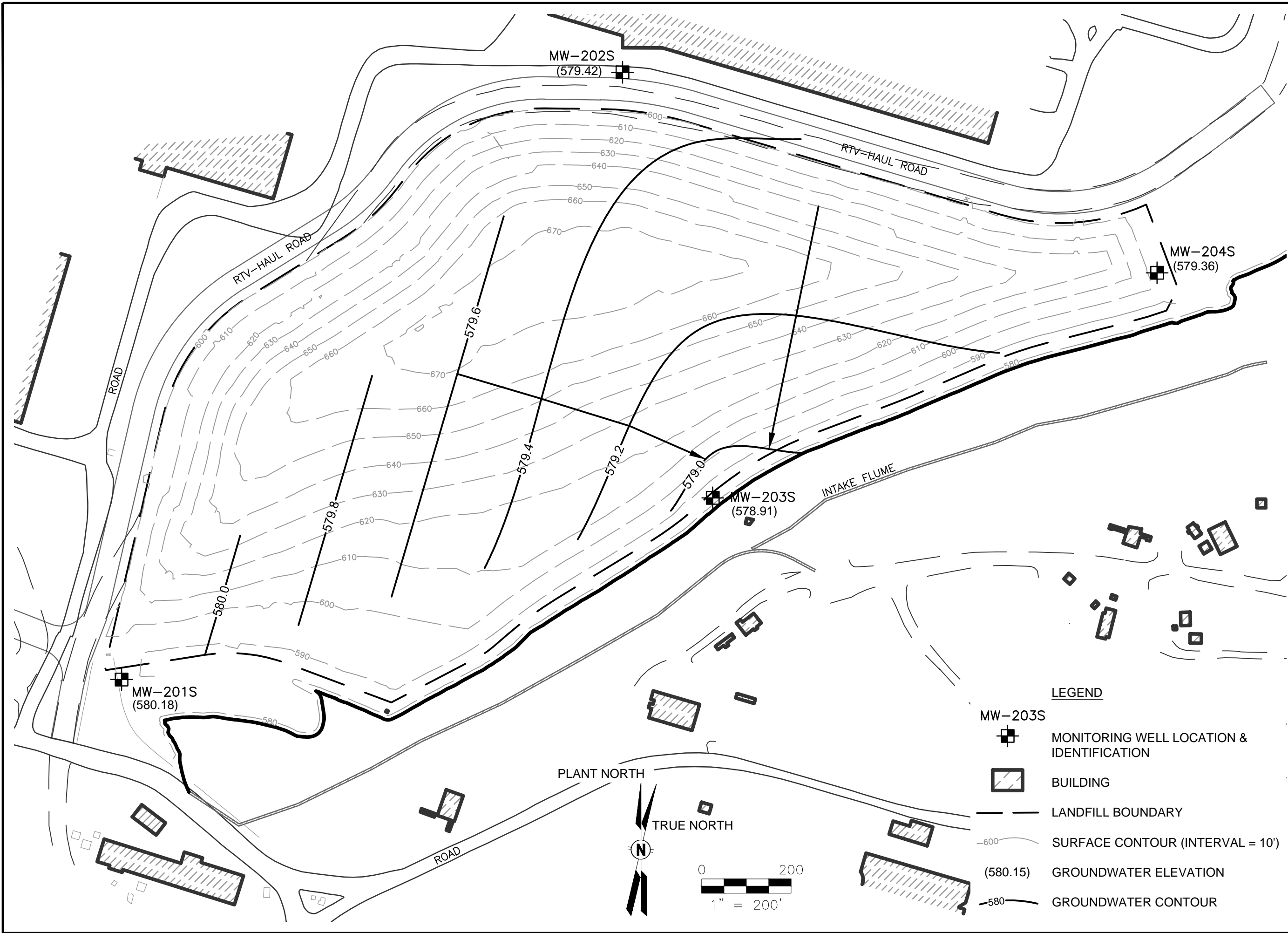


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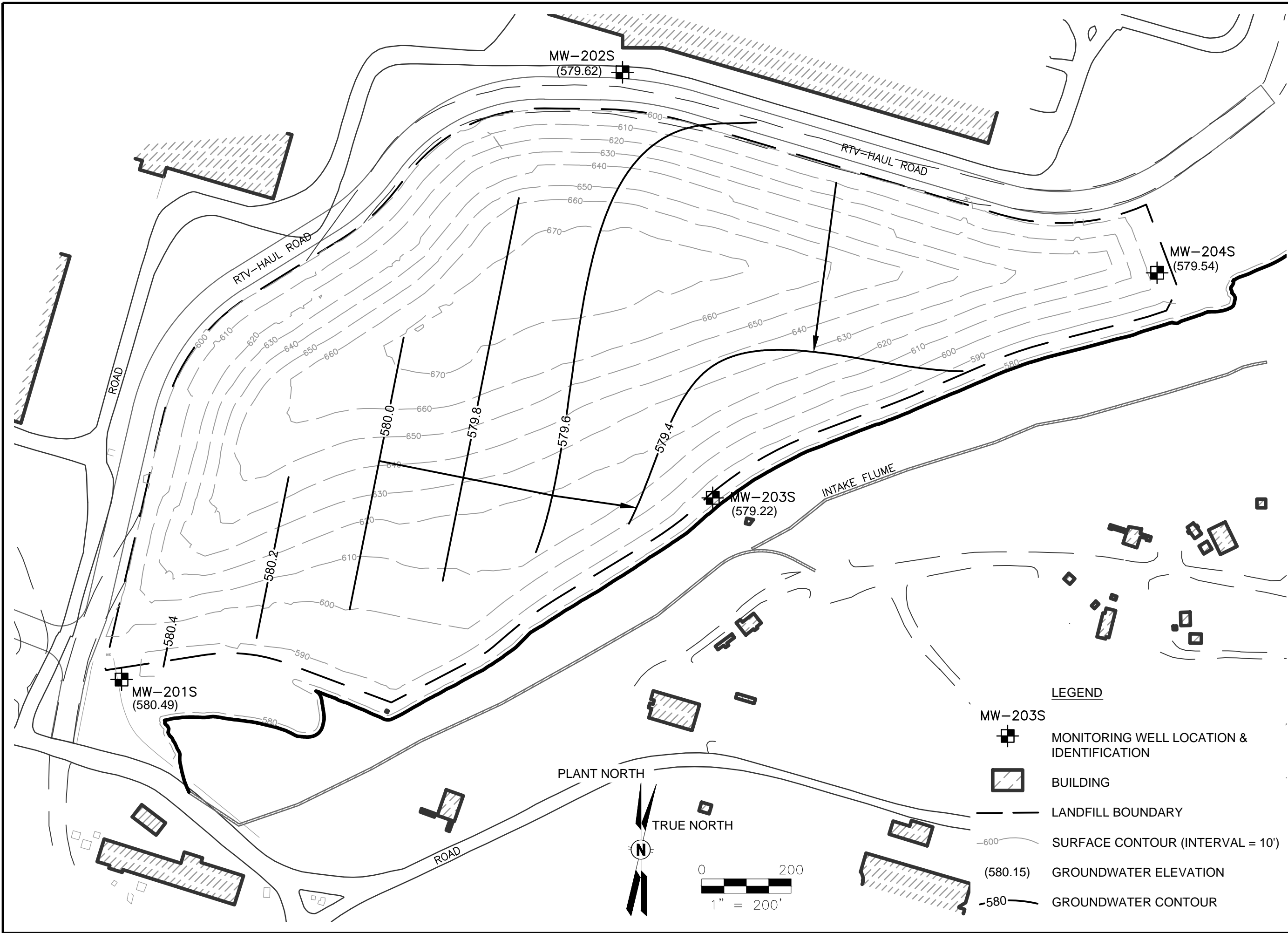
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EAST CHICAGO, INDIANA

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Approved: LLA 8/13/2012

PROJECT NUMBER 60157813

FIGURE NUMBER 4-5

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LEGEND

- MW-203S
 MONITORING WELL LOCATION & IDENTIFICATION
- BUILDING
- LANDFILL BOUNDARY
- SURFACE CONTOUR (INTERVAL = 10')
- (580.15) GROUNDWATER ELEVATION
- GROUNDWATER CONTOUR

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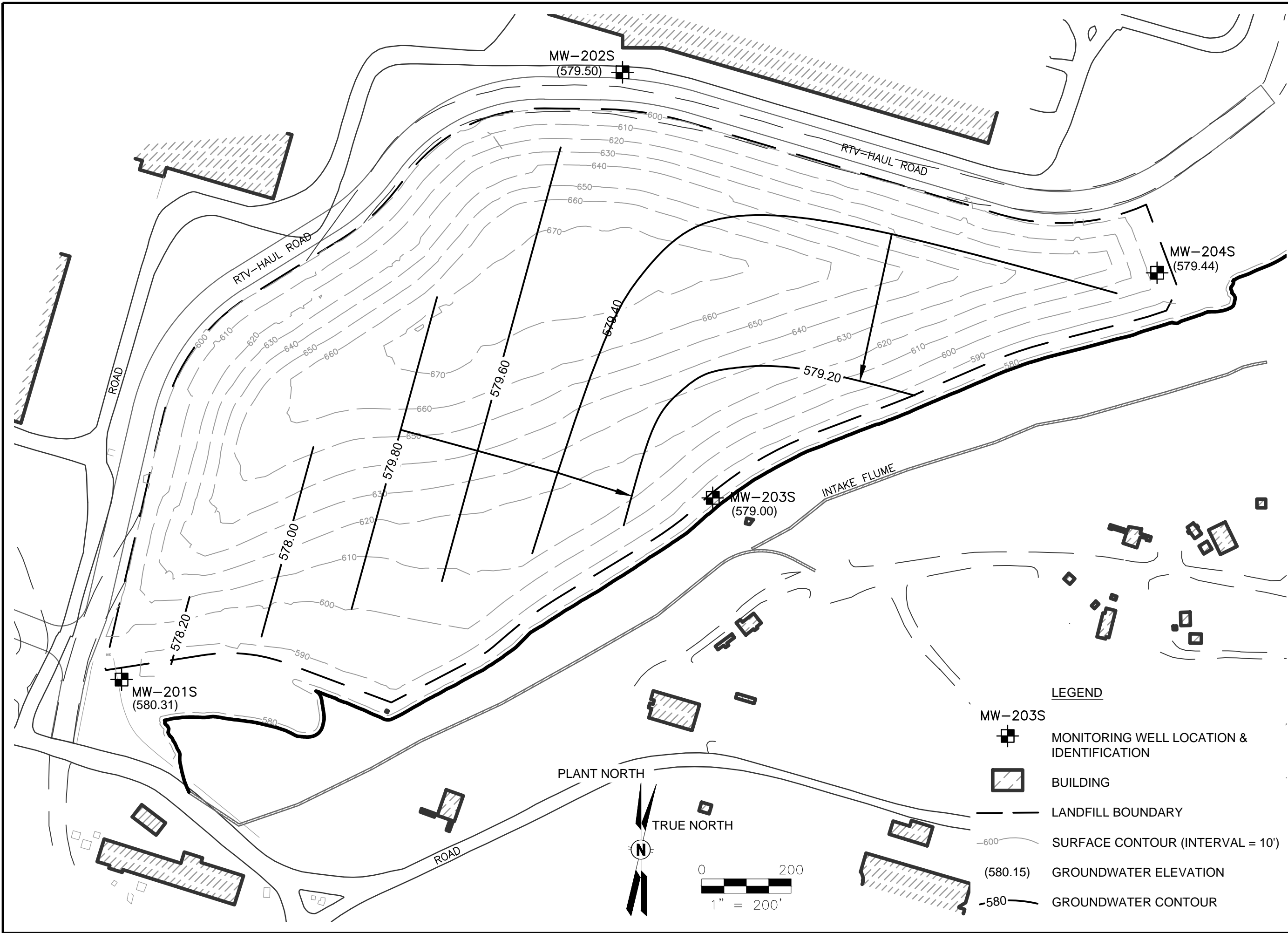
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PROJECT NUMBER 60157813

FIGURE NUMBER 4-6

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- 580 GROUNDWATER CONTOUR



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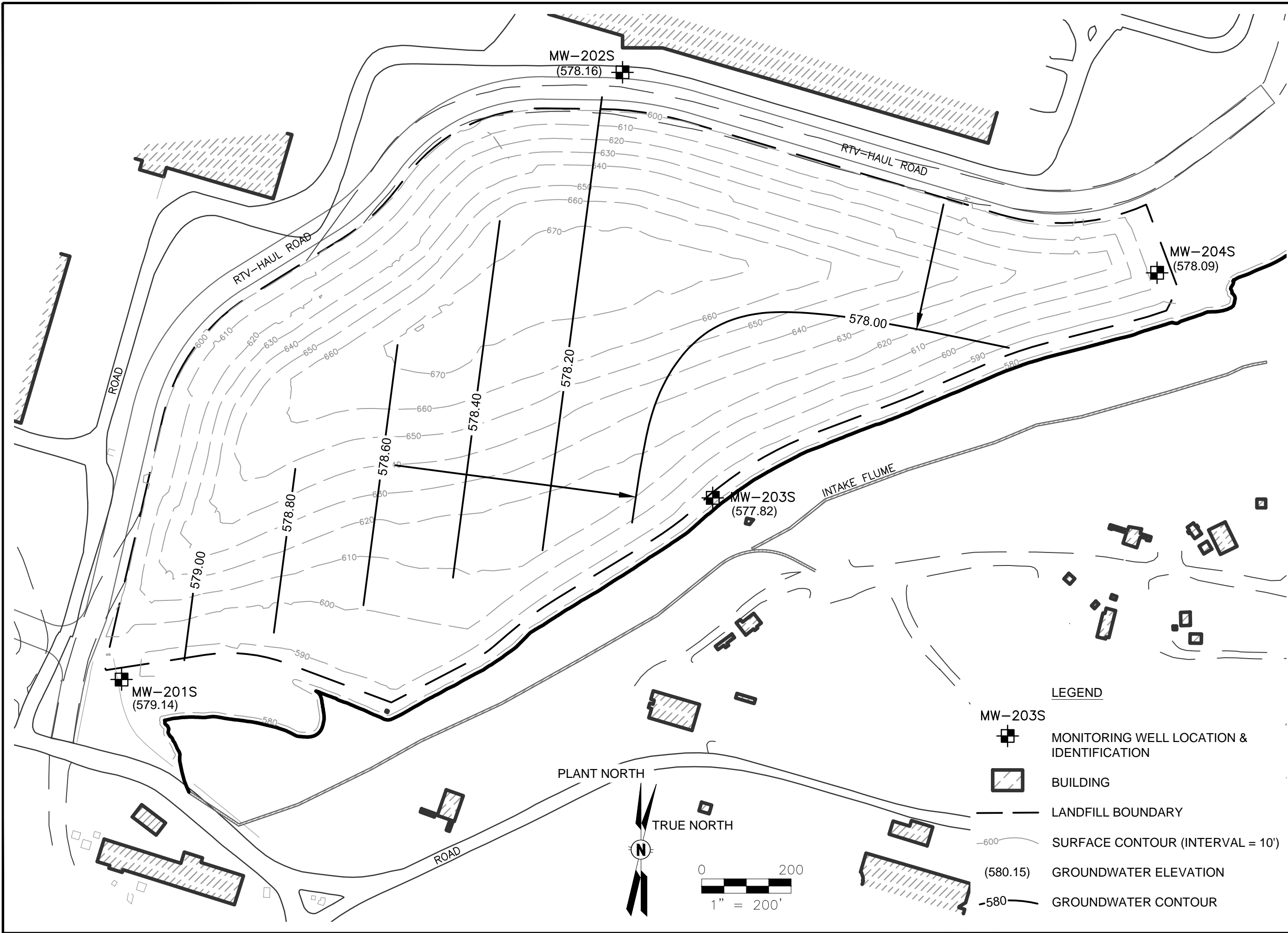
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FIGURE NUMBER	4-7	

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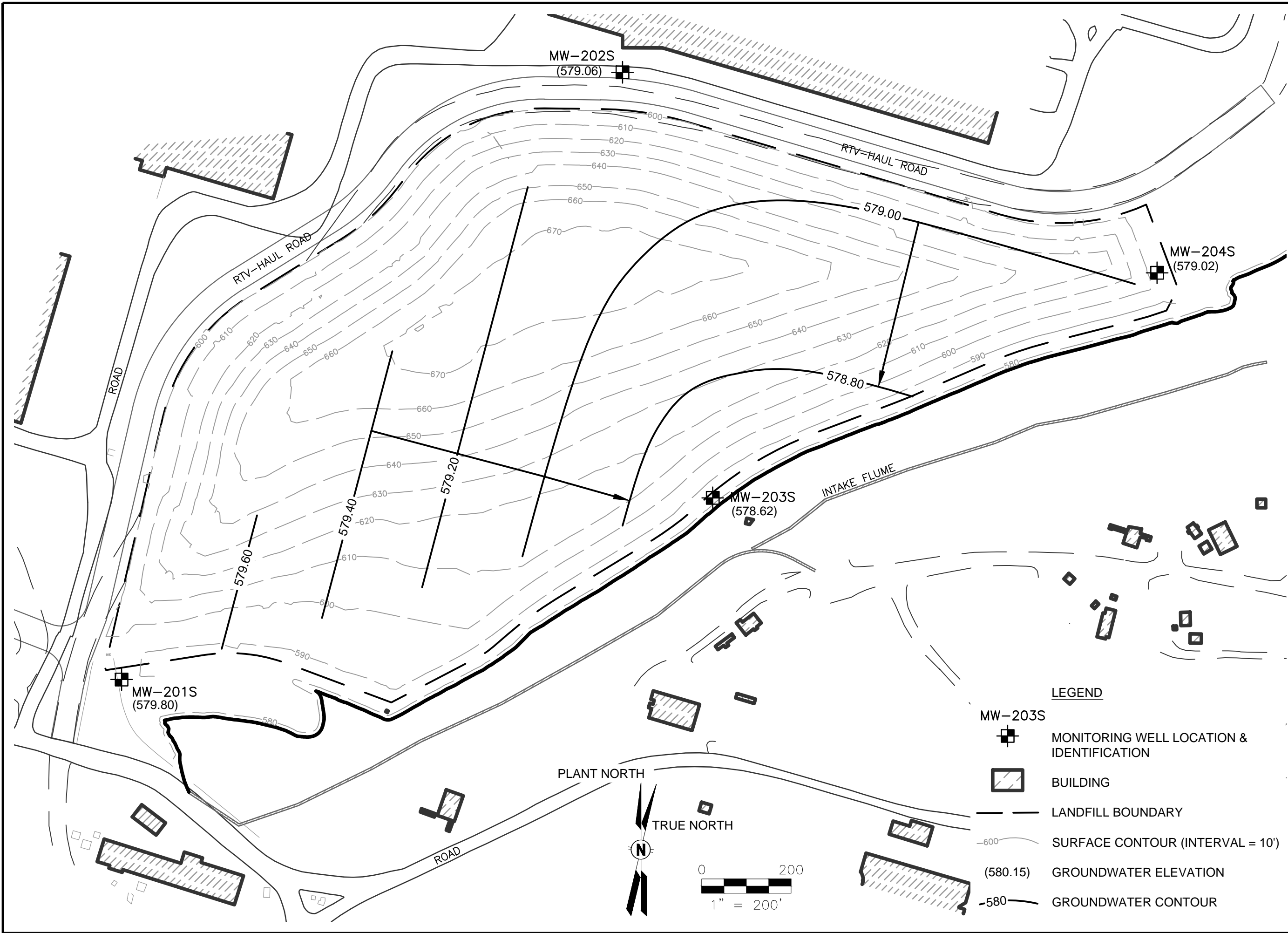
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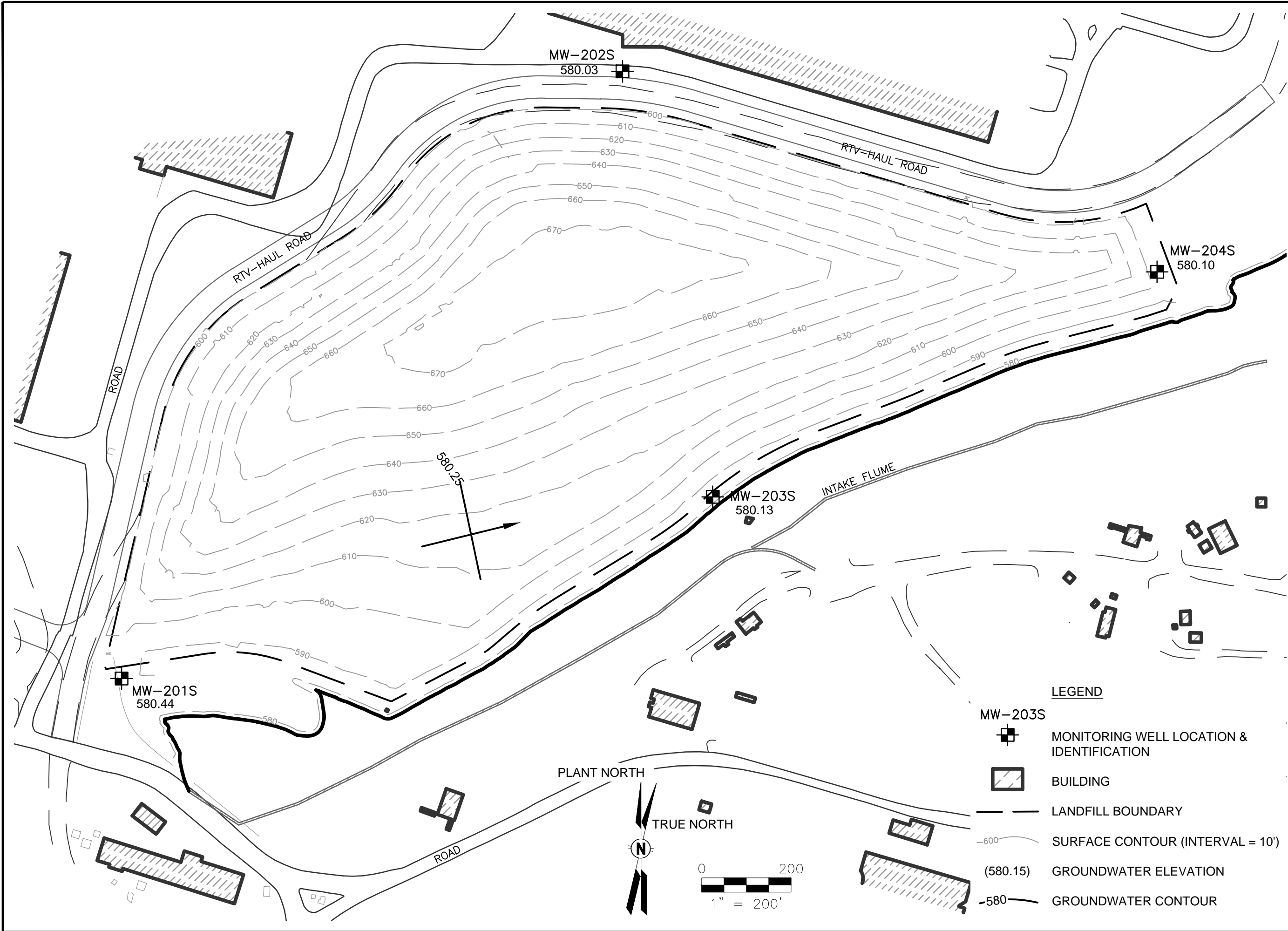
EAST CHICAGO, INDIANA

LEGEND

- MW-203S
- MONITORING WELL LOCATION & IDENTIFICATION
- BUILDING
- LANDFILL BOUNDARY
- SURFACE CONTOUR (INTERVAL = 10')
- (580.15) GROUNDWATER ELEVATION
- GROUNDWATER CONTOUR

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FIGURE NUMBER	4-9	

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 - [Hatched Rectangle Symbol] BUILDING
 - [Thick Line Symbol] LANDFILL BOUNDARY
 - SURFACE CONTOUR (INTERVAL = 10')
 - (580.15) GROUNDWATER ELEVATION
 - 580 GROUNDWATER CONTOUR



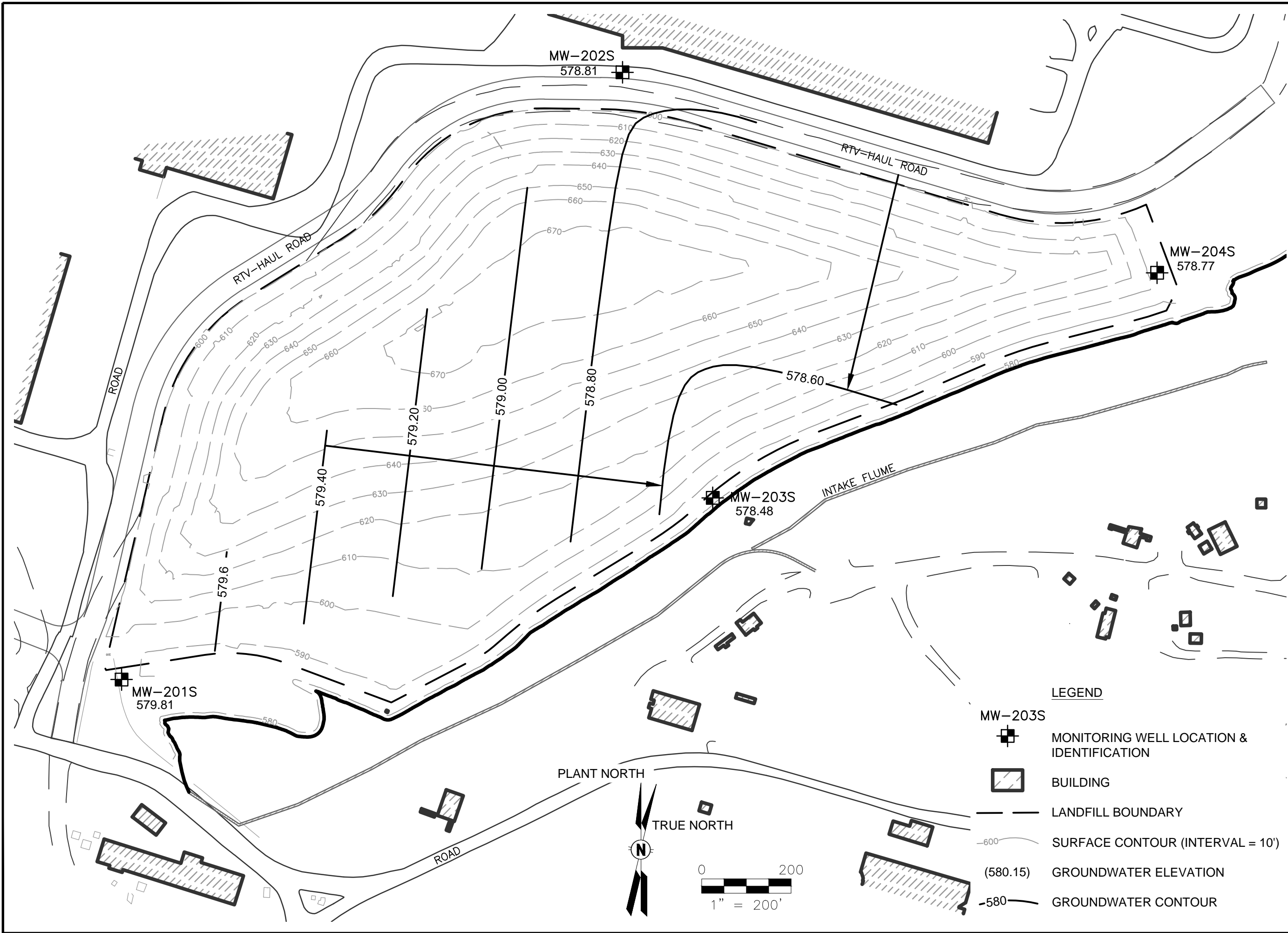
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LEGEND

- MW-203S
MONITORING WELL LOCATION & IDENTIFICATION
- BUILDING
- LANDFILL BOUNDARY
- SURFACE CONTOUR (INTERVAL = 10')
- (580.15) GROUNDWATER ELEVATION
- GROUNDWATER CONTOUR

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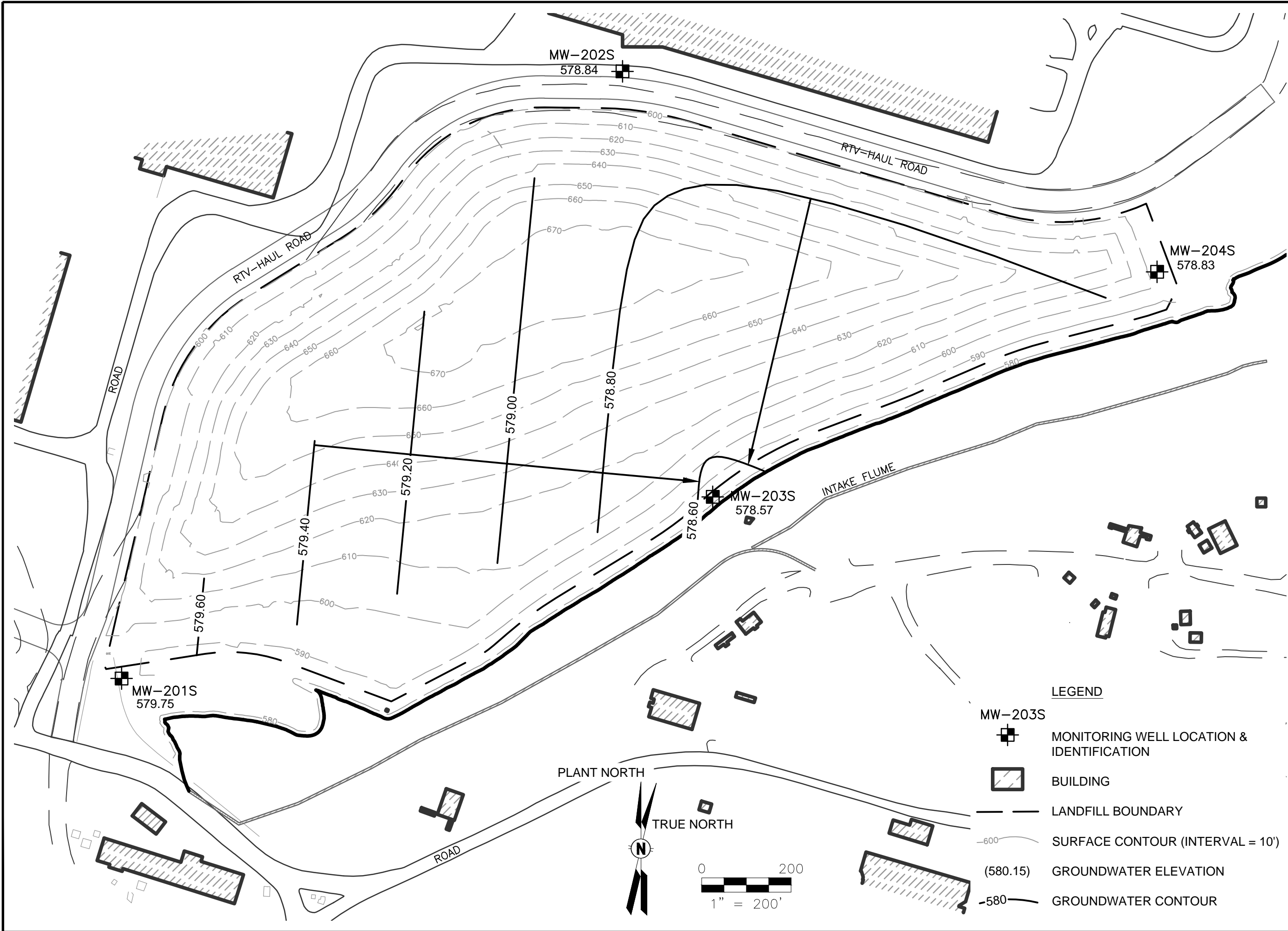
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PROJECT NUMBER 60157813

FIGURE NUMBER 4-11

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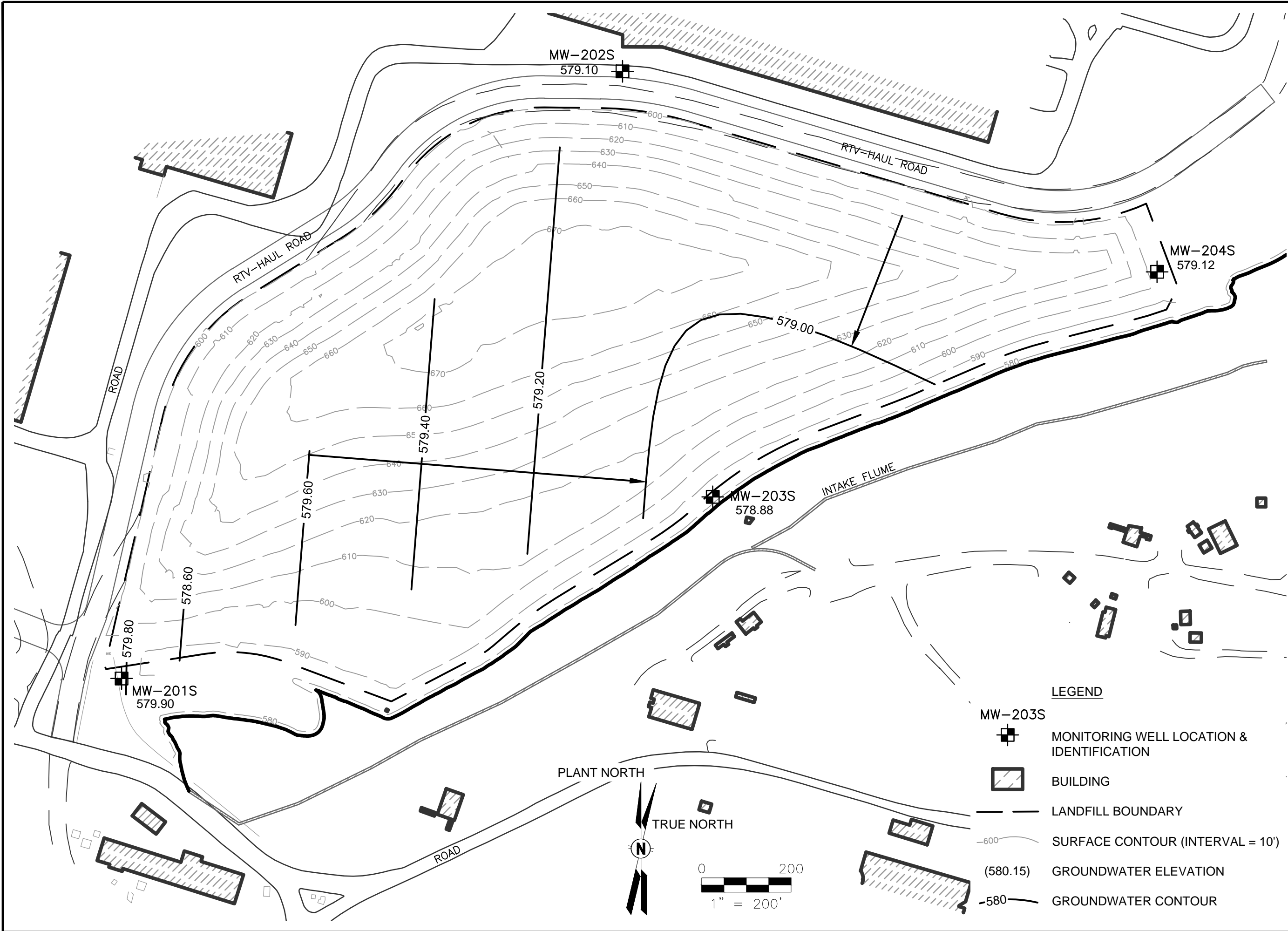
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EAST CHICAGO, INDIANA

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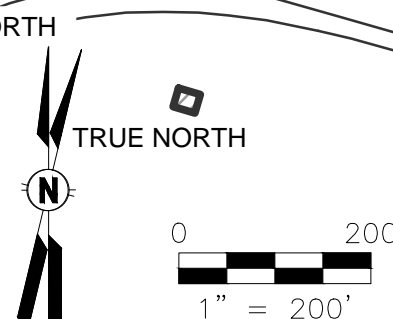
- MW-203S
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- LANDFILL BOUNDARY
- SURFACE CONTOUR (INTERVAL = 10')
- (580.15) GROUNDWATER ELEVATION
- GROUNDWATER CONTOUR

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FIGURE NUMBER	4-12

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- LEGEND**
- MW-203S
MONITORING WELL LOCATION & IDENTIFICATION
 - BUILDING
 - LANDFILL BOUNDARY
 - SURFACE CONTOUR (INTERVAL = 10')
 - (580.15) GROUNDWATER ELEVATION
 - GROUNDWATER CONTOUR



GROUNDWATER CONTOUR MAP MAY 31, 2012
CLARK LANDFILL
ARCELORMITTAL INDIANA HARBOR LLC.(WEST)
EAST CHICAGO, INDIANA

Drawn :	SAE 8/13/2012
Checked:	LLA 8/13/2012
Approved:	LLA 8/13/2012
PROJECT NUMBER	60157813
FIGURE NUMBER	4-13



SW = Surface Water monitoring point
Photo dated 2005 (pre-closure)

MW = Monitoring well (S= water table; D= base of Calumet aquifer directly above clay)

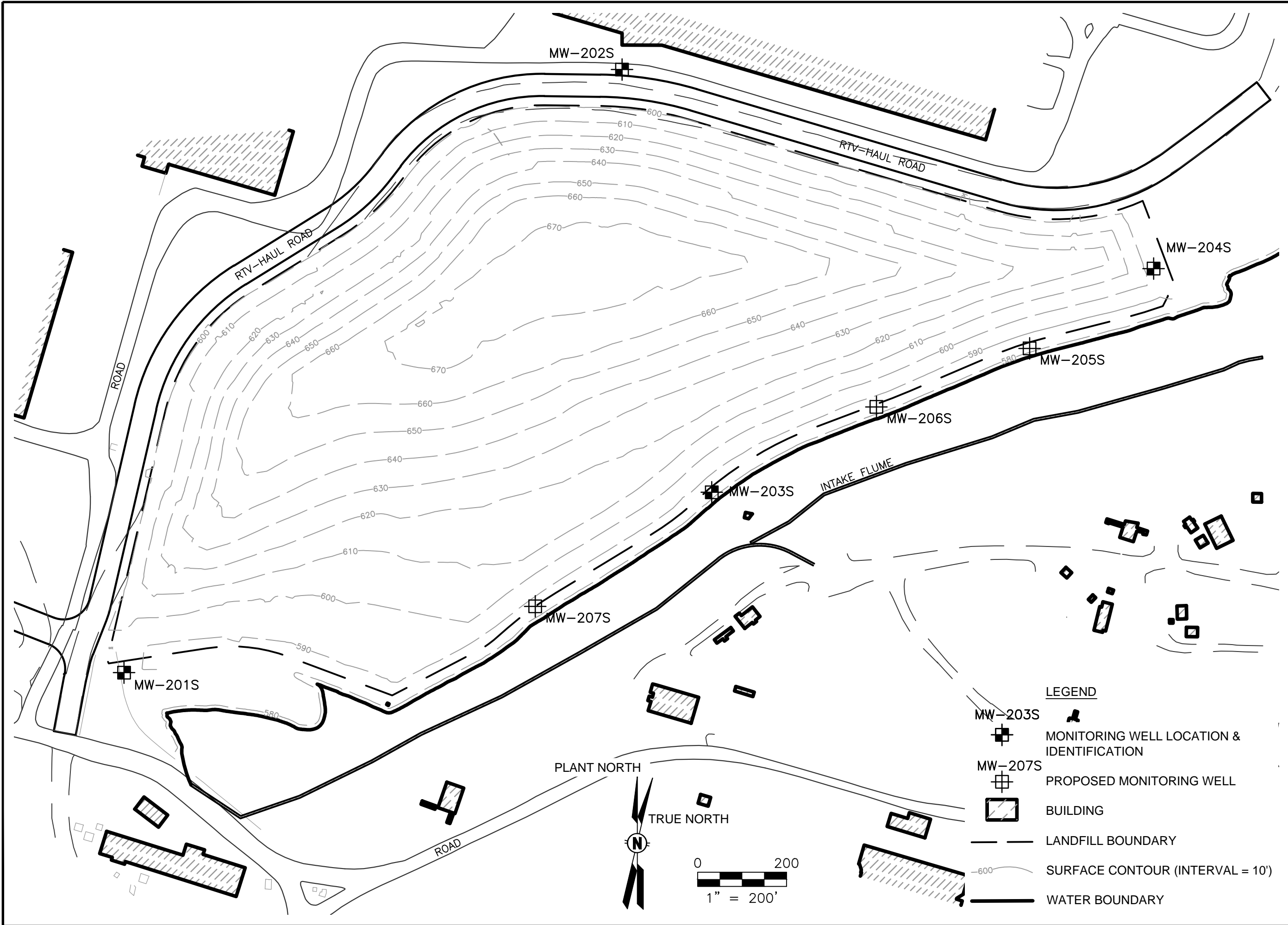
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ArcelorMittal Indiana Harbor LLC (West
Mill)
East Chicago, Indiana

Well Pair Locations

Figure 4-14

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PROPOSED MONITORING WELL LOCATIONS
CLARK LANDFILL
ARCELORMITTAL INDIANA HARBOR LLC. (WEST)
EAST CHICAGO, INDIANA

Drawn : SAP 8/13/2012
Checked: LLA 8/13/2012
Approved: LLA 8/13/2012

PROJECT NUMBER 60157783

FIGURE NUMBER 5-1

Appendix A

Clark Landfill Groundwater Sampling and Analysis Plan



Prepared for:
ArcelorMittal Indiana Harbor
East Chicago, Indiana

Prepared by:
AECOM
Milwaukee, WI
60196813
August 2012


Groundwater Sampling and Analysis Plan – Clark Landfill



Prepared for:
ArcelorMittal Indiana Harbor
East Chicago, Indiana

Prepared by:
AECOM
Milwaukee, WI
60196813
August 2012

Groundwater Sampling and Analysis Plan – Clark Landfill



Lanette L. Altenbach, C.P.G.



Steve C. Kornder, PhD

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Appendix A Field Procedures

1.0 Introduction

This Ground Water Sampling and Analysis Plan (GWSAP) has been prepared for the Clark Landfill site. The Clark Landfill is a Type 1 Restricted Waste Disposal Facility located at the ArcelorMittal Indiana Harbor (West Mill) located in East Chicago, Indiana. This plan describes routine sampling and analysis procedures in response to 329 Indiana Administrative Code 10-29.

The following plan covers the procedures for collecting representative samples from ground water monitoring wells and the basic laboratory requirements for obtaining valid, defensible data. The plan is limited to sampling and analysis requirements and does not include monitoring well placement, design and construction, or well development procedures. However, any well that becomes consistently dry or unserviceable may require replacement. Well replacements shall be installed in accordance with 329 IAC 10-21-4. All groundwater monitoring wells shall be easily visible and identified with the Agency monitoring point designation and a padlocked protective cover must be installed.

1.1 Involved Parties

Owner: ArcelorMittal Indiana Harbor LLC
3001 Dickey Road
East Chicago, IN

Owner's Representative: Tom Barnett

Consultant: AECOM

Consultant Contact: Steven C. Kornder, PhD

Laboratory: Microbac Laboratories
Merrillville, IN

2.0 Groundwater Sampling Program

This groundwater sampling program has been developed for the Clark Landfill for compliance with 329 IAC10-29-2 to describe the sampling procedures and to provide assurance that the groundwater samples will be collected and analyzed to provide a reliable indication of water quality in the zone being monitored.

2.1 Monitoring Wells

Clark Landfill monitoring wells will be sampled quarterly the first year, then semi-annually in subsequent years. Phase I detection monitoring parameters will be collected during the first year of sampling to determine background.

<u>Sampling Round</u>	<u>Parameters to be Monitored</u>
-----------------------	-----------------------------------

1st - April/May	Phase I detection monitoring parameters 329 IAC 10-29-6
-----------------	---

2nd - Oct/Nov	Phase I detection monitoring parameters 329 IAC 10-29-6
---------------	---

Ground water analytical data results will be submitted to the IDEM Commissioner semi-annually after background water quality is established following the submittal schedule required by the IDEM permit.

2.2 Groundwater Analysis Parameters

Phase I monitoring parameters will be used to develop background water quality for the Clark Landfill. Phase II monitoring will be implemented as needed based on statistical analysis of the Phase I monitoring results, after the background values have been established.

2.2.1 Phase I Monitoring

The Phase I monitoring parameters are shown in Table 1 and include the following:

- Field pH
- Specific conductance
- Chloride
- Boron
- Ammonia, nitrogen
- Sodium
- Chemical oxygen demand
- Total phenolics
- Methylene chloride
- 1,1-dichloroethane
- Toluene
- Benzene
- 1,2-dichloroethene, total
- Ethyl benzene
- 2-butanone, (methyl ethyl ketone)

The results of Phase I monitoring events will be reported within 60 days of the sample event.

2.2.2 Phase II Monitoring

A Phase II detection monitoring program meeting the requirements of 329 IAC 10-29-7 shall be implemented if two (2) parameters have statistically significant increases of Phase I detection parameters over background. The Phase II monitoring shall also include the secondary standards described in 329 IAC 10-29-7(c), the protection standards in 329 IAC 10-29-10(a) and any constituents determined by the IDEM Commissioner based on analysis of the disposed waste. Phase II detection monitoring shall continue for at least a one (1) year period until no significant increase is shown.

Phase II monitoring will include the constituents listed in 329 IAC 10-29-10 as included in Table 2. In addition the Phase II monitoring secondary standards listed in 329 IAC 10-29-7 are included in Table 2.

2.3 Evaluation and Reporting of Groundwater Analytical Data

Prior to analyzing the monitoring data, a brief data validation review will be conducted to verify that the data meets the data quality objectives. The validation will also assess data usability relative to USEPA data validation requirements USEPA 1985. Specifically, the data will be examined for blank contamination, poor matrix spike recoveries, etc. Data which does not meet validation requirements will be disqualified. Resampling and/or analysis of subsequent quarterly data will be conducted to corroborate analysis results.

The following section describes the evaluation procedures to be utilized at the facility downgradient wells at the monitoring boundary.

2.3.1 Phase I Monitoring Program

The Phase I monitoring data will be evaluated after each sampling period in conformance with 329 IAC 10-29-5. If a statistically significant increase is observed, in general conformance with 329 IAC 10-29-6(d) the owner will:

- Notify the IDEM Commissioner within fourteen (14) days;
- sample the wells for the Phase II monitoring program within 60 days; and
- report the results to the IDEM Commissioner.

2.3.2 Phase II Monitoring Program

A Phase II detection monitoring program meeting the requirements of 329 IAC 10-29-7 shall be implemented if two (2) parameters have statistically significant increases of Phase I detection parameters over background. The Phase II monitoring shall also include the secondary standards described in 329 IAC 10-29-7(c), the protection standards in 329 IAC 10-29-10(a) and any constituents determined by the IDEM Commissioner based on analysis of the disposed waste. Phase II detection monitoring shall continue for at least a one (1) year period until no significant increase is shown.

If the owner evaluates the data and a statistically significant increase is observed, the IDEM Commissioner shall be notified within fourteen (14) days. The notification will include which constituents have shown the statistically significant increases over background. If any constituent concentration meet or exceed two times the background level or the secondary maximum contaminant level established under 40 CFR 143.3, the owner will notify the IDEM Commissioner within 14 days.

If Phase II detection monitoring confirms that a release has occurred, reports of these analyses will be provided to the IDEM Commissioner in accordance with schedules identified by 329 IAC 10-29-7. If an alternate source of contamination not attributable to the landfill is confirmed under 329 IAC 10-29-8, a

report demonstrating the alternate source impact should be submitted to the IDEM Commissioner within 90 days. If an exceedance is confirmed, plans for corrective action shall be provided to the IDEM Commissioner in accordance with 329 IAC 10-29-9.

2.4 Corrective Action Program

A corrective action program will be developed as required by the IDEM Commissioner in general conformance with 329 IAC 10-29-9, if a statistically significant exceedance is confirmed and is attributable to the Clark Landfill.

3.0 Field Procedures

The field procedures to be used for sampling the groundwater monitoring wells are provided below.

3.1 Groundwater Sample Collection Overview

Prior to sampling, the water level in each well will be measured (see Section 3.1.1 below).

After the water level is measured, each well will be purged prior to sampling so that collected samples are representative of aquifer conditions. Wells will be purged using low-flow purging techniques with a low-flow peristaltic pump. The pump intake will be set near the center of the screened interval of the well. The purging rate will be selected to minimize drawdown in the well during purging (less than 0.5 feet). Purging will be considered complete when values of pH, temperature, specific conductance, and DO are within 10% for three consecutive readings.

There may be cases where the low-flow purge is not successful, for example, if the well becomes dewatered, or if parameters do not stabilize. If the well goes dry during purging, the sample will be collected once adequate water has re-entered the well. If parameter values do not stabilize, a minimum of three well volumes will be purged prior to sampling. Well volumes will be calculated to include the water stored in the sand pack around the wall.

Samples to be analyzed for metals will be submitted to the laboratory unfiltered (for total analyses). If necessary, samples will be filtered in the field, minimizing the delay between sample collection and filtering. Filtering will be conducted using an in-line filter with a 0.45 micron filter in accordance with standard practice.

For the groundwater sampling, pH, temperature, specific conductance, DO, and oxidation-reduction potential (or Eh) will be analyzed in the field. Procedures for these analyses are included in Appendix A, Field Procedure F201.

Groundwater samples will be collected using the purging equipment (disposable polyethylene bailer or low-flow peristaltic pump), placed in the appropriate sample containers and preserved as necessary. A list of analytical parameters, sample containers, and preservatives is provided in Table 3.

All sampling equipment will be decontaminated in accordance with procedures specified in Field Procedures F502 included in Appendix A.

3.1.1 Water Level Monitoring

Water levels in groundwater monitoring wells will be measured from the permanent point indicated at the top of the inner casing (the surveyed elevation point, usually the north side of the casing), using an electronic water level measuring device (water level indicator). The point of measurement will be documented in the field logbook if different from the top of the inner casing. The reason for deviating from the measurement point will also be noted.

Water levels are measured by lowering the probe into the well until the device indicates that water has been encountered, usually with either a constant buzz, or a light, or both. The water level is recorded

to the nearest foot (0.01) using the graduated markings on the water level indicator cord. This measurement, when subtracted from the measuring point elevation, yields the groundwater elevation.

3.2 Sample Handling

All equipment which contacts a sample before it is placed in a sample container will be new, disposable tubing or equipment that will not compromise sample integrity. If decontaminated sampling equipment will be stored prior to use, it will be wrapped in aluminum foil, plastic wrap or placed in a clean dedicated storage container.

Sampling personnel will wear new disposable nitrile gloves (non-powdered) while handling or transferring samples. Throughout this section, whenever gloves are mentioned in connection with sampling, reference is made to new non-powdered disposable nitrile gloves.

3.2.1 Sampling Containers

Table 3 lists sample container, preservation, and holding time requirements for the analytes and analyses proposed for groundwater monitoring. New, pre-cleaned containers will be provided by the laboratory. The laboratory will provide preservatives as appropriate. Samples will be transferred to the laboratory courier on-site or delivered to the laboratory.

3.2.2 Container Filling Sequence

Unless otherwise indicated, sample containers for analysis of different parameters will be filled in the following order: VOCs, dissolved metals, total metals, then other constituents. When filling containers with aqueous sample for VOC analysis, a positive meniscus will be maintained on the vial during closure so that no bubbles will be present in the VOA vials.

3.2.3 Sample Labeling

Sample labeling will occur at two points during sampling handling. An initial label is applied to the sample container when the sample is collected in the field. The second label is applied by the laboratory to the sample when it is logged into their laboratory information management system (LIMS). A description of each of these labeling practices follows.

3.2.3.1 Field Labeling

Sample labels will completed using waterproof ink will be affixed to each sample container. A unique sample identification code will be used for all samples collected. The sample identification code will be used on sample labels, COC forms, tables summarizing sampling locations or analytical results, and drawings illustrating sampling locations or analytical results.

The unique sample identification code will consist of the monitoring well name and the date of collection (i.e. MW-201S-[date of collection]). When a field duplicate sample is being collected and submitted for analysis, then the capital letter "D" shall be added after the date. This will designate that the sample was collected for field duplicate analysis.

Each sample container will be placed in a separate ziplock bag to ensure that if the label should, for any reason, become separated from the container, the container and label will be contained in the bag. The bag serves a secondary purpose in that it provides protection to the laboratory personnel in case the sample container breaks (if glass) in transit.

3.2.3.2 Laboratory Labeling

As described in the laboratory's QAP:

"All samples received at the laboratory are logged into a computerized LIMS which assigns a unique laboratory sample number to each samples. This sample number is used to identify all subsamples, and subsequent digestates or extracts prepared from the original sample. Moreover, each container for a given sample is issued a unique container identification number. This provides for an unequivocal link between the unique field ID and the sample contain used for analysis."

3.3 QC Sample Collection

QC samples will include trip blanks (associated with aqueous VOC samples only), method blanks and duplicate samples. These samples will be collected as described below:

Trip blanks - Trip blanks will be included in each shipment of aqueous VOC samples. Trip blanks will originate in the laboratory and be prepared by filling two 40-milliliter VOC vials with laboratory deionized water and sealing the vials with septum-lined caps (allowing no head space). Trip blanks will accompany the sample bottles to the laboratory.

Method Blanks - Method blanks are generated within the laboratory and used to assess contamination resulting from laboratory procedures. A method blank will be run each day, or at frequencies specified in the SOPs.

Duplicate Samples - Duplicate samples are analyzed to check for sampling and analytical reproducibility. Duplicate samples will generally be collected at a frequency of one for every ten or fewer investigative samples.

3.4 Chain of Custody Procedures

Custody is one of several factors necessary for the admissibility of environmental data as evidence in a court of law. Custody procedures help to satisfy the two major requirements for admissibility: relevance and authenticity. Sample custody is addressed in three parts: field sample collection, laboratory analysis, and final evidence files.

A sample or evidence file is considered to be under a person's custody if:

- The item is in the actual possession of a person.
- The item is in the view of the person after being in actual possession of the person.
- The item was in the actual physical possession of the person, but is locked up to prevent tampering.
- The item is in a designated and identified secure area.

Sample labels will be attached to each individual sample bottle. The label will include the field sample number (as described in Section 3.2.1.1), date/time of collection, type of analysis, and sampler initials. Labels will be annotated with waterproof, permanent ink. The sample will then be logged onto a chain of custody. The type of analyses requested will be noted on the chain of custody. Samples will be properly packaged for transport to the laboratory for analysis. A laboratory courier will pick up the samples at the site, or the samples will be delivered by the sampler to the laboratory.

4.0 Quality Assurance/Quality Control

For general reporting of quantitative results for ground water monitoring projects, the following reporting requirements apply:

- Methodology Summary - a table will be required listing all the analytical test methods used in the analyses of the samples with a reference made for each to the method manual and the test method number to confirm compliance with Tables 1 and 2.
- Summary of analytical results, indicating the appropriate units, reporting limit, and supervisor approval. Data will not be method blank corrected. It will be appropriately flagged.
- Chain-of-Custody Form - each sample collected will be included on the form. The chain of custody form will include the name and organization of the person collecting the samples, time and date of sampling. The chain of custody will be signed by each party holding the samples between the time of sample collection to the time of log-in at the laboratory. The entries must be legible.

Quality assurance and quality control procedures for the field and laboratory are further described in this section.

4.1 Data Quality Objectives

The data quality objectives for long term monitoring at the Clark Landfill are to collect representative groundwater samples and to analyze those samples to a reasonable degree of accuracy and precision so that the analysis can be determined to be representative of the groundwater up and downgradient from the Clark Landfill.

4.2 Quality Assurance Objectives for Measurement Data

The overall QA objective for this plan is to develop and implement procedures for field sampling, laboratory analysis, chain of custody (COC), and reporting that will provide results that are usable in risk evaluations and are legally defensible in a court of law.

4.3 Precision

Precision is a measure of the degree to which two or more measurements are in agreement.

4.3.1 Field Precision Objectives

Field precision is assessed through the collection and measurement of field duplicates at a rate of one duplicate per ten analytical samples. Precision will be measured through the calculation of relative percent difference (RPD) as described below in Section 4.3.2. The objectives for field precision are RPDs of 30% for aqueous samples provided that both the initial and field duplicate results are greater than five times the respective RLs. When one of both of the field duplicate sample results are reported at concentrations below five times the RL, precision will be accepted if the sample results agree within 2.5 times the RL for aqueous samples.

4.3.2 Laboratory Precision Objectives

Precision in the laboratory is assessed through the calculation of relative percent difference (RPD) for replicates and relative standard deviations (RSD) for three or more replicate samples. The RPD between the matrix spike and matrix spike duplicate, or sample and sample duplicate, or field duplicate pair is calculated to compare to precision DQLs. The RPD will be calculated according to the following formula:

$$RPD = \frac{(\text{Amount in Sample 1} - \text{Amount in Sample 2})}{0.5 (\text{Amount in Sample 1} + \text{Amount in Sample 2})} \times 100$$

For inorganic analyses, laboratory precision will be assessed through the analysis of Matrix Spike/Matrix Spike Duplicate (MS/MSD) laboratory duplicate pairs. For organic analyses, laboratory precision will be assessed through the analysis of MS/MSD samples.

4.4 Accuracy

Accuracy is the degree of agreement between the observed value and an accepted reference or true value.

4.4.1 Field Accuracy Objectives

Accuracy in the field is assessed through the use of field and trip blanks and through the adherence to all sample handling, preservation and holding time requirements.

4.4.2 Laboratory Accuracy Objectives

Laboratory accuracy is assessed through the analysis of matrix spikes (MSs) and Laboratory Control Samples (LCSs), and the determination of percent recoveries. The equations to be used for accuracy in this project can be found below. In order to assure the accuracy of the analytical procedures, a field sample will be spiked with a known amount of the analytes required by the referenced method on Tables 1 and 2. At a minimum, one spiked sample set ("matrix spike/matrix spike duplicate") should be included in every set of 20 samples. The increase in concentration of the analyte observed in the spiked sample, due to the addition of a known quantity of the analyte, compared to the reported value of the same analyte in the unspiked sample determines %R.

Accuracy is similarly assessed by determining %Rs for surrogate compounds added to each field and QC sample to be analyzed for the analytes listed on Table _____. Accuracy for all analyses will be further assessed through determination of %Rs for LCSs (as well as matrix spike samples).

%R for MS/MSD results will be determined according to the following equation:

$$\%R = \frac{(\text{Amount in Spiked Sample} - \text{Amount in Sample})}{\text{Known Amount Added}} \times 100$$

%R for LCS and surrogate compound results will be determined according to the following equation:

$$\%R = \frac{\text{Experimental Concentration}}{\text{Known Amount Added}} \times 100$$

4.5 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. "Normal conditions" are defined as the conditions expected if the sampling plan was implemented as planned.

4.5.1 Field Completeness Objective

Field completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project. The equation for completeness is presented in Section 4.5.2. The field completeness objective is greater than 90%.

4.5.2 Laboratory Completeness Objective

Laboratory completeness is a measure of the amount of valid measurements obtained from all the measurements taken in the project. The laboratory completeness objective is greater than 95%.

$$\text{Completeness} = \frac{(\text{number of valid measurements})}{(\text{number of measurements planned})} \times 100$$

4.6 Representativeness

Representativeness expresses the degree to which data accurately and precisely represents a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition within a defined spatial and/or temporal boundary.

4.6.1 Measures to Ensure Representativeness of Field Data

Representativeness is dependent upon the proper design of the sampling program and will be satisfied by ensuring that the procedures in this plan are followed, and that proper sampling techniques are used.

4.6.2 Measures to Ensure Representativeness of Laboratory Data

Representativeness in the laboratory is ensured by using the proper analytical procedures, appropriate methods, meeting sample holding times, and analyzing and assessing field duplicate samples. Quality control samples will be collected with each sample batch for each type of sample matrix. The list of analytes has been specified in 329 IAC 10-29-7 and 10-29-7. Analytical procedures and methods have been chosen to meet the DQLs selected for the project. Data validation will be performed to evaluate the effectiveness of the measures taken to ensure representativeness of the laboratory data.

4.7 Level of Quality Control Effort

Trip blanks, laboratory method blanks, field duplicate, laboratory duplicate, laboratory control samples, and matrix spike samples will be analyzed to assess the quality of the data. In general, the following QC measures will be used:

- Trip blanks consisting of deionized water will be submitted to the analytical laboratory to assess the potential for contamination of samples during sample shipment and storage;
- Method blank samples are generated within the laboratory and are used to evaluate the reported data for potential contamination from laboratory sample preparation and analytical procedures;
- Field and laboratory duplicate samples are analyzed to check for sampling and analytical reproducibility;
- LCSs are analyzed to check the analytical method performance in terms of analytical accuracy, or the degree of agreement between a measurement and the true or expected value; and,
- MS/MSDs provide information about the effect of the sample matrix on the sample preparation and measurement methodology. The laboratory will provide MS/MSD results from batch samples under a Level II quality control reporting program.

The general level of the QC effort will be one field duplicate for every 10 or fewer aqueous samples. One trip blank consisting of distilled deionized ultra pure water will be included along with each shipment of aqueous VOC samples.

5.0 Sampling Frequency - Detection/Verification Monitoring

5.1 Ground Water Monitoring Schedule

All monitoring wells shall be sampled semi-annually (quarterly the first year).

<u>Sampling Round</u>	<u>Parameters to be Monitored</u>
1st - April/May	Phase I detection monitoring parameters 329 IAC 10-29-6
2nd - Oct/Nov	Phase I detection monitoring parameters 329 IAC 10-29-6

Note: Phase I monitoring parameters are listed on Table 1.

Ground water analytical data results will be submitted to the IDEM Commissioner semi-annually after background water quality is established following the submittal schedule required by the IDEM permit.

5.2 Evaluation of Ground Water Monitoring Data

Prior to analyzing the monitoring data, a brief data validation review will be conducted to verify that the data meets the data quality objectives. The validation will also assess data usability relative to USEPA data validation requirements USEPA 1985. Specifically, the data will be examined for blank contamination, poor matrix spike recoveries, etc. Data which does not meet validation requirements will be disqualified. Resampling and/or analysis of subsequent quarterly data will be conducted to corroborate analysis results.

The following section describes the evaluation procedures to be used at the facility downgradient wells at the monitoring boundary. For the following observed increases, the IDEM Commissioner shall be notified within fourteen (14) days.

5.2.1 Wells Within the Uppermost Aquifer Downgradient from the Landfill

For downgradient wells at the monitoring boundary, the following occurrences will constitute an observed increase:

- A statistically significant increase at the 95 percent level of confidence detected and confirmed above background levels in accordance with procedures outlined in 329 IAC 10-29-5(3) for two (2) or more parameters.
- If upgradient wells indicate any change in water quality, background concentrations may be recomputed.

5.2.2 Additional Monitoring

If a statistically significant increase over background for two or more parameters is observed additional monitoring will be implemented, as required in 329 IAC 10-29-6(d)(2). This monitoring will include the following:

- Collection of additional samples within sixty (60) days of reporting an exceedance to the

- Commissioner.
- Determine the concentration of constituents identified in 329IAC 10-29-7(b) and (c) (see Table 2).
- Report the results to the commissioner.

Within a reasonable time period, a Phase II detection monitoring program will be established.

If an increase is not attributable to the landfill the procedures in 329 IAC 10-29-8 will be implemented. Sources outside the landfill may include, but are not limited to: natural phenomena; sampling or analysis error, or an off-site source. If an alternate source of contamination not attributable to the landfill is confirmed under 329 IAC 10-29-8, a report demonstrating the alternate source impact should be submitted to the IDEM Commissioner.

5.2.3 Phase II Detection Monitoring Program

A Phase II detection monitoring program meeting the requirements of 329 IAC 10-29-7 shall be implemented if two (2) parameters have statistically significant increases of Phase I detection parameters over background. The Phase II monitoring shall also include the secondary standards described in 329 IAC 10-29-7(c), the protection standards in 329 IAC 10-29-10(a) and any constituents determined by the IDEM Commissioner based on analysis of the disposed waste. Phase II detection monitoring shall continue for at least a one (1) year period until no significant increase is shown.

If an increase is not attributable to the landfill the procedures in 329 IAC 10-29-8 will be implemented. Sources outside the landfill may include, but are not limited to: natural phenomena; sampling or analysis error, or an off-site source. If an alternate source of contamination not attributable to the landfill is confirmed under 329 IAC 10-29-8, a report demonstrating the alternate source impact should be submitted to the IDEM Commissioner.

If Phase II detection monitoring confirms that a release has occurred, reports of these analyses will be provided to the IDEM Commissioner in accordance with schedules identified by 329 IAC 10-29-7. If an exceedance is confirmed, plans for corrective action shall be provided to the IDEM Commissioner in accordance with 329 IAC 10-29-9.

5.3 Data Evaluation

All data gathered through field activities or the laboratory operation will be reduced and validated prior to reporting. Laboratory validation comes from their internal QC program and reviews. The data will be provided electronically from the laboratory. Specific data review, statistical analysis and reporting are discussed below.

5.3.1 Field Data Reduction Procedures

DO, pH, redox, specific conductance, and PID readings will be transcribed directly from the instrument into the field logbook. If errors are made, results will be legibly crossed out, initialed and dated by the person recording the data, and corrected in a space adjacent to the original (erroneous) entry. Logbooks will be periodically reviewed by the project manager to ensure that records are complete, accurate, and legible.

5.3.2 Laboratory Data Management Procedures

Laboratory data reduction procedures will be performed according to the following protocol. All information related to analysis will be documented in controlled laboratory logbooks, instrument printouts, or other approved forms. All entries not generated by an automated data system will be made neatly and legibly in permanent, waterproof ink. Information will not be erased or obliterated. Corrections will be made by drawing a single line through the error and entering the correct information adjacent to the cross-out. All changes will be initialed, dated, and, if appropriate, accompanied by a brief explanation. Unused pages or portions of pages will be crossed out to prevent future data entry. Analytical laboratory records will be reviewed by the unit supervisors on a regular basis and by the Microbac QA Manager or designee periodically, to verify adherence to documentation requirements.

At Microbac, all sample receiving information is entered into the LIMS, rather than into a logbook. Additional relevant information may also be recorded in the LIMS (e.g., type/matrix of samples, turnaround time, client contact, analyses requested, date of sample disposal, etc.). As is the case with sample receiving information, sample preparation information is also entered and tracked in the LIMS in a structured analysis code. The preparation of all standards, surrogates, spiking solutions, and reference materials will be documented in a logbook or computerized reagent system.

Prior to being released from the laboratory as final, analytical data will proceed through a tiered review process. Each analyst will be responsible for reviewing the analytical and QC data that he/she has generated. As part of this review, the analyst will verify that:

- The appropriate methodology was used
- Instrumentation for functioning properly
- QC analyses were performed at the proper frequency and analyses met the acceptance criteria
- Samples were analyzed within holding times
- All analytes were quantitated within the calibration range
- Matrix interference problems were confirmed
- Method-specific analytical requirements were met (e.g., correlation coefficients)
- Calculations, dilution factors, and detection limits were verified

Data determined to be acceptable will be entered into the LIMS. Prior to releasing the final data, the Unit Supervisor or designee will review the data to:

- Verify the appropriate methodology was used
- Verify QC analyses were performed at the proper frequency and the analyses met the acceptance criteria
- Verify samples were analyzed within holding times
- Verify data in logbooks and instrument printouts were correctly entered into LIMS
- Review and document problems encountered during the analysis

The final data report will be reviewed and approved by the Laboratory Project Manager or Laboratory Manager prior to its release. This review will verify that the report format and content meet client specifications, the data was reported correctly, and analytical or QA problems were addressed, documented in the file, and, if appropriate, described in the case narrative.

5.3.3 Laboratory Data Reporting

The laboratory will provide at least one hard copy report and one copy of an EDD. The EDD will be provided in an Excel format or database-compatible format. This report will include the following information:

- Case narrative (see description below)
- Cross-reference of field sample IDs and laboratory IDs
- Method summary
- COC documentation
- Sample receipt checklist
- Dates of sample extraction and analysis
- Description of any data qualifiers used
- Sample results, including units
- Sample preparation information
- Results for batch QC including MS/MSDs, method or preparation/calibration blanks, LCSs, surrogates and laboratory duplicates

The case narrative will include the client name, project name and number, name of preparer, and a discussion of any deviations from analytical strategy, technical problems, and QC failures or nonconformances. The date of issuance will be presented on the report cover.

5.4 Data Validation

Data validation will be performed for both field and laboratory data acquired for the project investigations as described below.

5.4.1 Procedures Used to Validate Field Data

One hundred percent of the field analytical data will be validated. Procedures used to evaluate field data will include checking procedures utilized in the field, ensuring that field measurement equipment was properly calibrated, checking for transcription errors, and comparing the data to historic data or verifying its “reasonableness.” Evaluation of the field data acquired during each investigation will be the responsibility of the project manager or his designee (a qualified individual who is not a part of the field team).

5.4.2 Procedures to Validate Laboratory Data

The laboratory data will be validated in general conformance with the US EPA Guidance on Environmental Data Verification and Data Validation (US EPA QA/G-8, November 2002). Generally the validation will follow the format of the National Functional Guidelines, but because the National Functional Guidelines only apply to laboratory analysis under the CLP SOW, the description below provides the procedures to be used to validate data.

The purpose of the validation is to evaluate the analytical data in terms of certain prescribed criteria in order to assess the quality and usability of the data (e.g., usability as defined to meet the data quality objectives). During the validation process, each analytical result is flagged by a letter qualifier, as needed, or combination of qualifiers will indicate the usability of the result. For example, a “J” qualifier indicates that a result is usable, but represents an estimated value for the reason(s) given in the validation narrative. An “R” qualifier indicates that the result is rejected for the reason(s) stated in the narrative, and is therefore not a usable data point for the purposes of media characterization or a risk

assessment. The following are typical data qualifiers used during data validation and the corresponding definitions:

- U Not detected
- J Estimated value
- UJ Reported quantitation limit is qualified as estimated
- R Result is rejected and unusable

To enable the reviewer to conduct complete and comprehensive data validations, laboratory deliverables will include Level II QC, which includes batch quality control reporting.

The validation of analytical data will be performed by AECOM. Validation will consist of an evaluation of the following criteria:

- Sample/extract holding times
- Blanks
- Surrogate spike recoveries
- MS/MSDs recoveries and %RPDs (for the MSDs)
- MS recoveries and duplicate %RPDs for inorganics
- LCS recoveries and %RPDs
- %RPDs for field duplicates
- Reported detection limits

The results of the data validation will be included in reports provided to IDEM.

5.5 Statistical Evaluation

The groundwater sample results will be compared to established background water quality concentrations using the statistical procedures outlined in 329 IAC 10-29-5(3) for two (2) or more parameters. These statistical procedures will evaluate the data at a 95% confidence level to determine if there has been an exceedance of the background value and will incorporate the use of verification samples if appropriate. The statistical procedures may include any of the following:

Mann-Whitney U-test

Student's T-test

Temporal or spatial trend analysis

(or any other statistical analysis that is appropriate for the distribution of the data being evaluated)

Tables

Table 1 Phase I Monitoring Parameters

Table 2 Phase II Monitoring Parameters

Table 3 Container, Preservatives, Holding Times

Clark Landfill Groundwater Sampling Plan

ArcelorMittal Indiana Harbor West Mill

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Table1
Phase I Groundwater Monitoring Program Analyte List

Parameters	CAS #	Analytical			Acceptance Criteria		
		Prep/Method	MDL	PQL	LCS	MS/MSD	DUP
Field pH	None	SM 4500-H	0.1	0.1	*	*	*
Specific Conductance	None	SM 2510 B-1997	2	2	*	80-120	20
Chloride	16887-00-6	APHA 4500CL-B	1	1	80-120	80-120	20
Boron	7440-42-8	SW3010A/SW6020	0.004	0.02	85-115	70-130	20
Ammonia	7664-41-7	EPA 350.1	0.039	0.1	82.8-110	80.8-110	20
Sodium	7440-23-5	SW3010A/SW6020	0.0001	0.1	85-115	70-130	20
Chemical Oxygen Demand	None	EPA 410.4	7.8	10	79.7-113	71.6-127	20
Total Phenolics	None	SW9066	0.005	0.01	78.3-121	80.2-119	17.4
Methylene chloride	75-9-2	SW8260B	0.14	2	37.6-135	55.4-130	30
1,1-Dichloroethane	75-34-3	SW8260B	0.2	1	77-132	68-119	30
Toluene	108-88-3	SW8260B	0.2	1	76.4-123	69.7-130	30
Benzene	71-43-2	SW8260B	0.25	1	75.4-121	60.0-130	30
1,2-dichloroethene, total		SW8260B	0.36	1	63.3-117	68.2-110	30
Ethylbenzene	100-41-4	SW8260B	0.2	1	73.6-125	60.6-144	30
2-butanone (methyl ethyl ketone)		SW8260B	0.57	2	23.3-136	27.1-181	30

Microbac Laboratory Inc. MDLs are updated on an annual basis and based on these annual MDL studies, MDL and PQLs are subject to change.

Table 2
Phase II Groundwater Monitoring Program Analyte List

		CAS #	Analytical			Acceptance Criteria		
Parameters	Units		Prep/Method	MDL	PQL	LCS	MS/MSD	DUP
Groundwater Quality Standard Inorganics								
Arsenic	mg/L	7440-38-2	SW3010A/SW6020	0.002	0.01	85-115	70-130	20
Barium	mg/L	7440-39-3	SW3010A/SW6020	0.0004	0.002	85-115	70-130	20
Cadmium	mg/L	7440-43-9	SW3010A/SW6020	0.0002	0.001	85-115	70-130	20
Chromium	mg/L	7440-47-3	SW3010A/SW6020	0.0006	0.003	85-115	70-130	20
Fluoride	mg/L	16984-48-8	SM 4500-F C1997	0.01	0.1	90-110	80-120	20
Lead	mg/L	7439-92-1	SW3010A/SW6020	0.001	0.005	85-115	70-130	20
Mercury	mg/L	7439-97-6	SW7470A	2.00E-05	0.0002	80-120	75-125	20
Nitrate, as Nitrogen	mg/L	84145-82-4	EPA 353.2	0.001	0.1	80-120	81.3-131	20
VOCs								
Acetone	ug/L			0.71	5	47.5-144	66.1-113	30
Acrolein	ug/L	107-02-8	SW8260B	5.79	10	*	*	30
Acrylonitrile	ug/L	107-13-1	SW8260B	3.93	10	19.6-200	37.6-200	30
Benzene	ug/L	71-43-2	SW8260B	0.25	1	75.4-121	60.0-130	30
Bromoform	ug/L	75-25-2	SW8260B	0.82	1	60-131	40.5-146	30
2-butanone (methyl ethyl ketone)	ug/L	78-93-3	SW8260B	0.57	2	23.3-136	27.1-181	30
Carbon disulfide	ug/L	75-15-0	SW8260B	0.22	2	44.1-200	76.4-186	30
Carbon tetrachloride	ug/L	56-23-5	SW8260B	0.17	1	65.5-134	47.2-149	30
Chlorobenzene	ug/L	108-90-7	SW8260B	0.18	1	81.1-120	75.6-127	30
Chlorodibromomethane	ug/L	124-48-1	SW8260B	0.29	1	68.6-123	53-149	30
Chloroethane	ug/L	75-0-3	SW8260B	0.29	2	58.8-124	64.8-121	30
2-Chloroethyl vinyl ether	ug/L	110-75-8	SW8260B	0.49	2	10-200	10-200	30
Chloroform	ug/L	67-66-3	SW8260B	0.19	1	74.1-123	51-138	30
Dichlorobromomethane ^C	ug/L	75-27-4	SW8260B	0.14	1	69.4-121	65.8-126	30
Dibromomethane	ug/L	75-95-3	SW8260B	0.19	1	67-130	74-132	30
Dichlorodifluoromethane	ug/L	75-71-8	SW8260B	0.46	2	10-134	10-137	30
1,1-Dichloroethane	ug/L	75-34-3	SW8260B	0.2	1	77-132	68-119	30
1,2-Dichloroethane	ug/L	107-6-2	SW8260B	0.15	1	68-127	63.4-134	30
1,2-dichlorethene, total	ug/L	107-6-2	SW8260B	0.36	1	63.3-117	68.2-110	30
cis-1,3-Dichlororopane	ug/L	142-28-9	SW8260B	0.22	1	69.1-126	53.5-135	30
trans-1,3-Dichloropropane	ug/L	142-28-9	SW8260B	0.21	1	71.8-131	69.9-130	30
Ethylbenzene	ug/L	100-41-4	SW8260B	0.2	1	73.6-125	60.6-144	30
Methyl Bromide (Bromomethane)	ug/L	74-83-9	SW8260B	0.72	2	11.7-112	21.7-119	30
Methyl Chloride (Chloromethane)	ug/L	74-87-3	SW8260B	0.33	2	22.5-147	46.1-113	30
Ethyl methacrylate	ug/L	97-63-2	SW8260B	1	1	*	*	*
2-hexanone	ug/L	591-78-6	SW8260B	0.29	2	55.9-119	52.4-118	30
Iodomethane	ug/L	74-88-4	SW8260B	0.12	10	*	*	30
Methylene chloride	ug/L	75-9-2	SW8260B	0.44	2	37.6-135	55.4-130	30
4-methyl-2-pentanone	ug/L	108-10-1	SW8260B	0.25	1	61.5-127	59.7-120	30
styrene	ug/L	100-42-5	SW8260B	0.22	1	66.9-133	58.4-136	30
1,1,2,2-Tetrachloroethane	ug/L	79-34-5	SW8260B	0.35	1	69.8-123	46-157	30
Toluene	ug/L	108-88-3	SW8260B	0.2	1	76.4-123	69.7-130	30
1,1,1-Trichloroethane	ug/L	74-55-6	SW8260B	0.24	1	70.8-131	63-136	30
1,1,2-Trichloroethane	ug/L	79-00-5	SW8260B	0.23	1	67.6-127	40.6-165	30
Trichloroethene	ug/L	86-42-0	SW8260B	0.14	1	69.9-127	71-157	30
Trichlorofluoromethane	ug/L	75-69-4	SW8260B	0.42	2	55.1-156	58.1-156	30
1,2,3-trichloropropane	ug/L	96-18-4	SW8260B	0.14	1	45.1-111	46.3-125	30
Vinyl acetate	ug/L	108-05-4	SW8260B	0.2	2	43.8-178	69.3-156	30
Vinyl chloride	ug/L	75-1-4	SW8260B	0.48	2	37.1-149	33-151	30
Xylenes, total	ug/L	1330-20-7	SW8260B	0.61	1	65.1-117	73.7-115	30
Secondary Standards								
Chloride	mg/L	16887-00-6	APHA 4500CL-B	1	1	80-120	80-120	20
Copper	mg/L	7440-50-8	SW3010A/SW6020	0.002	0.01	85-115	70-130	20
Iron	mg/L	7439-89-6	SW3010A/SW6020	0.02	0.1	85-115	70-130	20
Manganese	mg/L	7439-96-5	SW3010A/SW6020	0.0004	0.002	85-115	70-130	20
Sulfate	mg/L	14808-79-8	SW-846 9038	0.4	10	*	72.4-117	20
Total dissolved solids	mg/L	67-16-3	SM 2540 C-1997	18	20	90.3-106	*	20
Zinc	mg/L	7440-66-6	SW3010A/SW6020	0.004	0.02	85-115	70-130	20

- Microbac Laboratory Inc. MDLs are updated on an annual basis. Based on these annual MDL studies, MDL and PQLs are subject to change.

Table 3
Sample Container, Preservation, and Holding Time Requirements

Parameter	Bottle Requirements ⁽¹⁾	Preservation Requirements	Holding Time ⁽²⁾
VOCs	3-40ml glass vials with Teflon lined septum	4°C; HCl	14 days
Metals	1, 500-ml plastic	4°C , HNO ₃	180 days except mercury is 28 days
Chloride/Fluoride	1, 125-ml plastic	4°C	28 days
Ammonia	1, 250-ml plastic	4°C, H ₂ SO ₄	28 days
Nitrate as nitrogen	1, 250-ml plastic	4°C, H ₂ SO ₄	28 days
Chemical oxygen demand	1, 125-ml plastic	4°C, H ₂ SO ₄	28 days
Total Phenolics	1, Liter Amber glass	4°C, H ₂ SO ₄	28 days
Sulfate	1, 125-ml plastic	4°C	28 days
Total Dissolved Solids	1, Liter plastic	4°C	7 days

⁽¹⁾ Laboratory may provide one larger container for all analyses listed except VOCs.

⁽²⁾ Holding times are based on time of sample collection.

Appendix A

Field Procedures

F201
ON-SITE WATER QUALITY TESTING
(FIELD PARAMETERS)

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F201
ON-SITE WATER QUALITY TESTING
(FIELD PARAMETERS)

1.0 PURPOSE

This Procedure describes the methods and equipment required to measure the following parameters of an aqueous sample in the field:

- pH
- Specific Conductance
- Temperature
- Dissolved Oxygen Concentration (DO)

The first three are the usual field parameters; DO may be used in particular applications according to project requirements.

2.0 SCOPE

These procedures are applicable for use in an on-site water quality monitoring program to be conducted for example during a remedial investigation or site investigation at a hazardous or non-hazardous site. The procedures and equipment described are applicable to nearly all aqueous samples, including potable well water, monitoring well water, surface water, leachate and drummed water, etc.

This procedure provides generic information for measuring the parameters listed above with instruments and techniques in common use. Since instruments from different manufacturers may vary, review of the manufacturer's literature pertaining to the use of a specific instrument is required before use.

3.0 DEFINITIONS

Conductance - A measurement of water's capacity for conveying electrical current and is directly related to the concentrations of ionized substances in the water. The units of measurement for conductance (mhos) are the inverse of ohms, the unit commonly used to express resistance. Conductivity and specific conductance are used synonymously.

Electrolytic Cell - An electrochemical cell in which electrical energy is supplied from an external source. This cell functions in much the same way as a galvanic cell, only in the opposite direction due to the external source of applied voltage.

Galvanic Cell - An electrochemical cell in which chemical energy is spontaneously converted to electrical energy. The electrical energy produced is supplied to an external circuit.

Oxidation - The process in which an atom or a group of atoms loses electrons to achieve an increasing positive charge.

pH - The negative logarithm (base 10) of the hydrogen ion activity. The hydrogen ion activity is related to the hydrogen ion concentration, and, in a relatively weak solution, the two are nearly equal. Thus, for all practical purposes, pH is a measure of the hydrogen ion concentration. The range of pH is 0 to 14 standard units (s.u.).

Resistance - A measure of the solution's ability to oppose the passage of electrical current. For metals and solutions, resistance is defined by Ohm's Law, $E = IR$, where E is the potential difference (in units of volts), I is the current (in units of Amperes), and R is the resistance (in units of ohms).

Secchi disc - A metal disc having four quadrants, two opposing ones painted black and the other two either white or unpainted. The Secchi disc is used to measure turbidity based on the depth of light penetration; typically used in slow moving or stagnant surface waters.

Turbidity - An optical property of water that causes light to be scattered or absorbed in the water, resulting in decrease of water transparency. It is a function of at least three variables: 1) dissolved chemicals, such as tannins, acids, or salts; 2) suspended particles, such as silt, clay, and organic matter; and, 3) density of microbial and planktonic life.

4.0 RESPONSIBILITIES

Project Manager (PM) - The PM is responsible for ensuring that project-specific plans are in accordance with these procedures, where applicable, or that other, approved procedures are developed. The PM is responsible for determining which on-site water quality measurements shall be made, the data quality objectives (DQOs) for these measurements, and for ensuring that these measurements are made in accordance with project-specific plans.

Field Team Leader (FTL) - The FTL is responsible for determining that these water quality measurement methods are implemented in the field in accordance with this standard procedure, or in accordance with project-specific plans, and to ensure that personnel performing sampling activities have been briefed and trained to execute these procedures.

Sampling Personnel - It is the responsibility of the field sampling personnel to follow these procedures for collecting on-site water quality measurements including instrument calibration, quality control and recording of results, as well as care and maintenance of the instruments in the field.

5.0 PROCEDURES

The following sections provide general procedures for collecting pH, specific conductance, temperature, DO concentration, and ORP measurements.

5.1 Measurement of pH

Measurement of pH is one of the most important and frequently used tests in water chemistry. Practically every phase of water supply and wastewater treatment, such as acid-base neutralization, water softening, and corrosion control, is pH dependent. Likewise, the pH of leachate can be correlated with other chemical analyses to determine the probable source of contamination. It is therefore important that reasonably accurate pH measurements be taken.

Measurements of pH also can be used to check the quality and corrosivity of soil and solid waste samples. However, these samples must be immersed in water prior to analysis and require specific laboratory measurement techniques for solids that are not described herein.

Two methods are given for pH measurement: the pH meter and pH indicator paper. The indicator paper is used when only a rough estimate of the pH is required; the pH meter is used when a more accurate measurement is required. The response of a pH meter can be affected to a slight degree by high levels of colloidal or suspended solids, but the effect is usually small and generally of little significance. Consequently, specific methods to overcome this interference are not described. The response of pH paper is unaffected by solution interferences from color, turbidity, colloidal or suspended materials unless extremely high levels capable of coating or masking the paper are encountered. Nonetheless, most cases require the use of a pH meter will be required.

5.1.1 Principles of Equipment Operation

Use of pH papers for pH measurement relies on a chemical reaction caused by the acidity or alkalinity of the solution with the indicator compound on the paper. Depending on the indicator and the pH range of interest, a variety of different colors can be used. Typical indicators are weak acids or bases, or both. Process chemistry and molecular transformations leading to the color change are variable and complex.

Use of a pH meter relies on the same principle as other ion-specific electrodes. Measurement relies on the establishment of a potential difference across a glass or other type of membrane. The membrane is conductive to ionic species and, in combination with a standard or reference electrode, a potential difference proportional to hydrogen ion concentration can be generated and measured.

5.1.2 Equipment

The following equipment and reagents are needed for taking pH measurements:

- Portable pH meter, or pH indicator paper, such as Mydrion or Alkacid, to cover the pH range 2 through 12.
- Laboratory-prepared buffer solutions of pH 4, 7, and 10, or other buffers which bracket the expected pH range.

5.1.3 Measurement Techniques for Field Determination of pH

pH Meter

Standardization, calibration, and operation and maintenance shall be performed according to the manufacturer's instructions. The following is a general procedure used for measuring pH with a pH meter:

1. The batteries shall be checked to make sure that they are fully charged and the instrument shall be calibrated prior to initiation of the field effort.
2. Immerse the tip of the electrodes in water overnight. If this is not possible due to field conditions, immerse the electrode tip in water for at least an hour before use. The electrode tip may be immersed in a rubber or plastic sack containing buffer solution for field transport or storage. This is not applicable for all electrodes as some must be stored dry.
3. Turn meter on and allow it to stabilize for 3 to 5 minutes.
4. The accuracy of the buffer solutions used for field and laboratory calibration shall be checked. Buffer solutions need to be changed often due to degradation upon exposure to

the atmosphere. Select two pH buffers; 7, 4 and/or 10; in expected sample range and check temperatures of each. Record pertinent information in field logbook.

5. Make sure all electrolyte solutions within the electrode(s) are at their proper levels and that no air bubbles are present within the electrode(s).

6. Immerse the electrode(s) in a pH 7 buffer solution.

7. Adjust the temperature compensator to the proper temperature (on models with automatic temperature adjustment, immerse the temperature probe into the buffer solution). It is best to maintain the buffer solution at or near expected sample temperature before calibration, if possible.

8. Adjust the pH meter to read 7.0.

9. Remove the electrode(s) from the buffer and rinse well with distilled-deionized water. Immerse the electrode(s) in pH 4 or 10 buffer solution (depending on the expected pH of the sample) and adjust the slope control to read the appropriate pH. For best results, the standardization and slope adjustments shall be repeated at least once.

10. The calibration procedure should be performed or repeated:

- Following significant ambient temperature changes,
- When meter reads erratically, and
- At beginning and middle of each day of use.

11. When the meter is moved to a new sampling location, a single-point calibration should be performed with pH 7 buffer.

12. Immerse the electrode(s) in the unknown solution, slowly stirring the probe until the pH stabilizes. Stabilization may take several seconds to minutes. If the pH continues to drift, the sample temperature may not be stable, a chemical reaction (e.g., degassing) may be taking place in the sample, or the meter or electrode may be malfunctioning. This must be clearly noted in the logbook.

13. After adjusting the temperature compensator to the sample temperature, read and record the pH of the solution. The pH value shall be recorded to the nearest 0.1 pH unit. Also record the sample temperature. All measurements shall be recorded in the field logbook.

14. Upon completion of measurement and removal of the electrode from the sample, the electrode shall be thoroughly rinsed with deionized water.

15. The electrode(s) shall remain immersed in deionized water when not in use.

- The sample used for pH measurement shall never be saved for subsequent conductivity or chemical analysis. All pH electrodes leak small quantities of electrolytes (e.g., sodium or potassium chloride) into the solution. Precipitation of

saturated electrolyte solution within the electrode, especially at colder temperatures, or in cold water, may result in slow electrode response. Any visual observation of conditions which may interfere with pH measurement, such as oily materials, or turbidity, shall be noted in the field logbook.

pH Paper

Use of pH paper is very simple and requires no sample preparation, standardization, etc. pH paper is available in several ranges, including wide-range (indicating approximately pH 1 to 12), mid-range (approximately pH 0 to 6, 6 to 9, or 8 to 14) and narrow-range (many available, with ranges as narrow as 1.5 pH units). The appropriate range of pH paper shall be selected. If the pH is unknown, the investigation shall start with wide-range paper.

5.2 Measurement of Specific Conductance

Conductance provides a measure of dissolved ionic species in water and can be used to suggest the direction and extent of migration of contaminants in groundwater or surface water. Conductivity is a numerical expression of the ability of a water sample to carry an electric current. This value depends on the total concentration of the ionized substances dissolved in the water and the temperature at which the measurement is made. The mobility of each of the various dissolved ions, their valences, and their actual and relative concentrations affect conductivity.

It is important to obtain a specific conductance measurement soon after taking a sample, since temperature changes, precipitation reactions, and absorption of carbon dioxide from the air all affect the specific conductance.

5.2.1 Principles of Equipment Operation

An aqueous system containing ions will conduct an electric current. In a direct-current field, the positive ions (cations) migrate toward the negative electrode (cathode), while negatively charged ions (anions) migrate toward the positive electrode (anode). Most inorganic acids, bases and salts (such as hydrochloric acid, sodium carbonate, or sodium chloride, respectively) are relatively good conductors. Conversely, organic compounds such as sucrose or benzene, which do not disassociate in aqueous solution, conduct a current very poorly, if at all.

A conductance cell and a Wheatstone Bridge (for the measurement of potential difference) may be used for measurement of electrical resistance. The ratio of current applied to voltage across the cell also may be used as a measure of conductance. The core element of the apparatus is

the conductivity cell containing the solution of interest. Depending on ionic strength of the aqueous solution to be tested, a potential difference is developed across the cell which can be converted directly or indirectly (depending on instrument type) to a measurement of specific conductance.

5.2.2 Equipment

A portable conductivity meter, probe and thermometer are needed for taking specific conductance measurements. A variety of conductivity meters are available which also may be used to monitor salinity and temperatures. Probe types and cable lengths vary, so equipment may be obtained to meet the specific requirements of the sampling program.

5.2.3 Measurement Techniques for Specific Conductance

Standardization, calibration, and operation and maintenance shall be performed according to manufacturer's instructions. The steps involved in taking specific conductance measurements are listed below.

1. Check batteries to make sure they are fully charged and calibrate instrument before going into the field.
2. Calibrate the instrument daily when used. Potassium chloride solutions with a specific conductance closest to the values expected in the field shall be used. Calibration information shall be recorded in the field logbook.
3. Turn meter on and allow it to stabilize for 3 to 5 minutes.
4. Pour approximately 50 to 100 ml of standard conductance solution (0.1 Molar Potassium Chloride), 1413 micromhos, into a rinsed plastic cup.
5. Rinse probe with distilled water and blot dry with paper towel.
6. Place probe in reference solution and adjust the calibration on meter to read value of reference solution. Confirm and document proper operation/reading against standard solution.
7. Remove probe and rinse with distilled water. Blot the end of the probe dry with paper towel.
8. This calibration procedure should be performed:
 - Following significant ambient temperature changes,
 - When meter reads erratically, and
 - At beginning and middle of each day of use.

9. Pour approximately 50 to 100 ml of sample into a rinsed plastic cup. Immerse the electrode in the sample and measure the conductivity. If specified, adjust the temperature setting to the sample temperature.
10. Read and record the results in the field logbook.
11. If the meter does not automatically compensate for temperature variations, attempts will be made to adjust the conductivity reading such that the temperature is 25°C. In such cases, conductivity will be reported along with the associated temperature and shall be reported as “corrected to 25°C”.

The following formula must be used to normalize data to 25°C:

$$K = \frac{(K_m)(C)}{1 + 0.0191(T-25)}$$

Where: K = conductivity in µmhos/cm at 25°C

K_m = measured conductivity in µmhos/cm at T degrees C

C = cell constant

T = measured temperature of the sample in degrees C

If the cell constant is 1, the formula for determining conductivity becomes:

$$K = \frac{(K_m)(C)}{1 + 0.0191(T-25)}$$

5.3 Measurement of Temperature

In combination with other parameters, temperature can be a useful indicator of the likelihood of biological action in a water sample. It can also be used to trace the flow direction of contaminated groundwater. Temperature measurements shall be taken in-situ, or as quickly as possible in the field prior to sample collection. Collected water samples may rapidly equilibrate with the temperature of their surroundings.

5.3.1 Equipment

Temperature measurements may be taken with thermistor, alcohol-toluene, mercury or bimetal thermometers. In addition, various meters such as specific conductance or DO meters, which have temperature measurement capabilities, may also be used. Using such instrumentation along with suitable probes and cables, in-situ measurements of temperature can be performed.

5.3.2 Measurement Techniques for Water Temperature

If a thermometer is used on a collected water sample:

1. Visually inspect the thermometer to ensure that there is not a break in the mercury column. If there is a break, the spare thermometer will be visually inspected. If both thermometers have a break in the mercury, neither will be used until the break is corrected. This will be done by cooling the bulb until the mercury is contained within the bulb.
2. Immerse the thermometer in the sample until temperature equilibrium is obtained (1 to 3 minutes). To avoid the possibility of contamination, the thermometer shall not be inserted into samples which will undergo subsequent chemical analysis.
3. Record values in a field logbook to the nearest 0.5 or 0.1°C, depending on the measurement device used.

If a temperature meter or probe is to be used, the instrument shall be calibrated according to the manufacturer's recommendations with an approved thermometer.

5.4 Measurement of Dissolved Oxygen Concentration

DO levels in natural water and wastewater depend on the physical, chemical and biochemical activities in the water body. Conversely, the growth of many aquatic organisms, as well as the rate of corrosivity, are dependent on the DO concentration. Thus, analysis for DO is a key test in water pollution and waste treatment process control. If at all possible, DO measurements shall be taken in-situ, since concentration may show a large change in a short time, if the sample is not adequately preserved.

The method discussed here is limited to the use of DO meters only. Chemical methods of analysis (i.e., Winkler methods) are available, but require more equipment and greater sample manipulation. Furthermore, DO meters, using a membrane electrode, are suitable for highly polluted waters, because the probe is completely submersible. DO meters also are free from interference caused by color, turbidity, colloidal material or suspended matter.

5.4.1 Principles of Equipment Operation

DO probes normally are electrochemical cells that have two solid metal electrodes of different potential immersed in an electrolyte. The electrolyte is retained by an oxygen-permeable membrane. The metal of higher nobility (the cathode) is positioned at the membrane. When a suitable potential exists between the two metals, reduction of oxygen to hydroxide ion (OH⁻)

occurs at the cathode surface. An electrical current is developed directly proportional to the rate of arrival of oxygen molecules at the cathode.

Since the current produced in the probe is directly proportional to the rate of arrival of oxygen at the cathode, it is important that a fresh supply of sample always be in contact with the membrane. Otherwise, the oxygen in the aqueous layer along the membrane is quickly depleted and false low readings are obtained. It is therefore necessary to stir the sample (or the probe) constantly to maintain fresh solution near the membrane interface. Stirring, however, shall not be so vigorous that additional oxygen is introduced through the air-water interface at the sample surface. To avoid this possibility, some probes are equipped with stirrers to agitate the solution near the probe, but to leave the surface of the solution undisturbed.

DO probes are relatively free of interferences. Interferences that can occur are reactions with oxidizing gases (such as chlorine) or with gases such as hydrogen sulfide which are not easily depolarized from the indicating electrode. If gaseous interference is suspected, it shall be noted in the field logbook and checked if possible. Temperature, pressure, and salinity variations also can cause interference. Automatic temperature compensation normally is provided by the manufacturer.

5.4.2 Equipment

The following, similar or equivalent, equipment is needed to measure DO concentration:

- YSI Model 33 DO monitor (or equivalent).
- DO/temperature probe.
- Sufficient cable to allow the probe to contact the sample.

5.4.3 Measurement Techniques for Dissolved Oxygen Determination

Probes differ as to specifics of use. Follow the manufacturer's instructions to obtain an accurate reading. The following general steps shall be used to measure the DO concentration.

1. Calibrate equipment and check batteries in the laboratory before going to the field.
2. The probe shall be conditioned in a water sample for as long as practical before use in the field. Long periods of dry storage followed by short periods of use in the field may result in inaccurate readings.
3. The instrument shall be calibrated in the field before each measurement or group of closely spaced measurements by placing the probe in a water sample of known DO

concentration (i.e., determined by Winkler method) or in a freshly air-saturated water sample of known temperature.

4. Immerse the probe in the sample. Be sure to provide for sufficient flow past the membrane, either by stirring the sample, or placing the probe in a flowing stream. Probes without stirrers which are placed in wells should be moved up and down.
5. Record the DO content and temperature of the sample in a field logbook.
6. Recalibrate the probe when the membrane is replaced, or following similar maintenance, or as needed. Follow the manufacturer's instructions.

Note that in-situ placement of the probe is preferable, since sample handling is not involved. This, however, may not always be practical. Be sure to record whether the liquid was analyzed in situ, or whether a sample was taken.

Special care shall be taken during sample collection to avoid turbulence which can lead to increased oxygen dissolution and positive test interferences.

5.5 Measurement of Oxidation-Reduction Potential

Oxidation-reduction potential (ORP) is an important water chemistry parameter, providing a measurement of the oxidizing or reducing nature of the water. As pH is a measurement of proton activity and is used to assign a value to the acidity or alkalinity of a system, ORP is the analogous measurement for electron activity and is useful in assigning a value to oxidizing or reducing systems. The oxidizing or reducing nature of water has implications in its ability to support (or not support) life, or the corrosiveness of the water, for example.

The measurement of ORP is a direct potentiometric measurement of the equilibrium established between all oxidized and reduced species in solution.

5.5.1 Principles of Equipment Operation

ORP measurements are made using an electrode pair consisting of a reference electrode, a sensing electrode, and a high-impedance input meter with millivolt display to 0.1 mV. The sensing element for ORP is a noble metal such as gold or platinum. These metals are stable against chemical oxidation and can either provide or accept electrons as the ORP potential is established at the electrode surface. Platinum is the most commonly employed metal for most water systems. The ORP reading is recorded to the nearest millivolt.

Unlike the pH measurement, it is not possible to calibrate the electrode for a response of ORP. However, it is good practice to verify the working operation of the measurement system, namely the meter and electrode system. The first step is to short the electrode input on the meter. The millivolt reading should be ± 0.5 mV. Second, with the electrode connected to the meter, the electrode/meter system can be checked by placing the electrode in a standard ORP solution.

5.5.2 Equipment

The following equipment is needed for taking ORP measurements:

- Portable ORP meter such as Hanna Instruments Model 108 ORP with a range of ± 999 mV
- Commercially available standard ORP solution with a range of 200 to 275 mV at 25°C/77°F.

5.5.3 Measurement Techniques for ORP

Standardization, calibration and operation and maintenance shall be performed according to manufacturers instructions. The steps involved in taking specific conductance measurements are listed below:

- Remove the protective cap.
- Turn the meter by pressing the POWER switch.
- Immerse it in the solution to be tested without exceeding the maximum immersion level.
- Stir gently and wait for the reading to stabilize.
- After use, rinse the electrode with tap water to minimize contamination.
- Always replace the protective cap after use.

6.0 QUALITY ASSURANCE RECORDS

Quality assurance records for on-site water quality management consist principally of observations and measurements recorded in the field logbook.

7.0 REFERENCES

American Public Health Association, 1980. Standard Methods for the Examination of Water and Wastewater. 15th Edition, APHA, Washington, D.C.

US EPA, 1979. Methods for Chemical Analysis of Water and Wastes. EPA - 600/4-79-020.

US Geological Survey, 1984. National Handbook of Recommended Methods for Water Data Acquisition, Chapter 5: Chemical and Physical Quality of Water and Sediment. U.S. Department of the Interior, Reston, Virginia.

F502
DECONTAMINATION OF SAMPLING AND MONITORING EQUIPMENT

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F502

DECONTAMINATION OF SAMPLING AND MONITORING EQUIPMENT

1.0 PURPOSE

The purpose of this Procedure is to provide a general methodology and protocol, and to reference information for the proper decontamination of field chemical sampling and analytical equipment.

2.0 SCOPE

This procedure applies to all field sampling equipment including, but not limited to, split-barrel soil samplers (split-spoons), bailers, beakers, trowels, filtering apparatus, pumps, and associated tubing. This procedure should be consulted when decontamination procedures are being developed as part of project-specific plans. Additionally, current USEPA regional procedures and decontamination guidance as well as state guidance should be reviewed.

3.0 DEFINITIONS

Decontamination - Decontamination is the process of removing or neutralizing contaminants which may have accumulated on field equipment. This process ensures protection of personnel from penetrating substances, reduces or eliminates transfer of contaminants to clean areas, prevents mixing of incompatible substances, and minimizes the likelihood of sample cross-contamination.

4.0 RESPONSIBILITIES

Project Manager (PM) - It is the responsibility of the PM to ensure that project-specific plans are in accordance with these procedures. Documentation should be developed for areas where project plans deviate from these procedures.

Field Team Leader (FTL) - It is the responsibility of the FTL to ensure that these procedures are implemented in the field. The FTL is responsible for ensuring field personnel performing decontamination activities have been briefed and trained to execute these procedures.

Sampling Personnel - It is the responsibility of field sampling personnel to follow these procedures, or to follow documented, project-specific procedures as directed by the FTL.

5.0 PROCEDURES

In order to ensure that chemical analysis results reflect actual concentrations present at sampling locations, sampling equipment must be properly decontaminated prior to the field effort, during the sampling program (i.e., between sampling locations) and at the conclusion of the sampling program. This will minimize the potential for cross-contamination between sampling locations and the transfer of contamination off site.

Preferably, sampling equipment should be dedicated to a given sampling location. If this is not possible, equipment must be decontaminated between sampling locations. Sampling personnel must use disposable gloves and change them between sampling locations.

5.1 Sampling Equipment Decontamination Procedures

Soil and sediment sampling equipment including, but not limited to trowels, beakers, dredges, etc., shall be decontaminated using the following USEPA procedures.

Prior to use, all sampling equipment should be carefully cleaned using the following procedure:

1. Clean with tap water and laboratory detergent (e.g., Alconox) using a brush if necessary to remove particular matter and surface films.
2. Rinse thoroughly with tap water.
3. Rinse thoroughly with distilled-deionized water and allow to air dry.
4. If appropriate, the equipment will be wrapped in aluminum foil to ensure its cleanliness during storage and transportation.
 - Portable power augers and/or any other large soil boring/drill rigs with high pressure steam washers will be cleaned prior to drilling operations. Depending on the site, the drilling equipment will be washed between boreholes.
 - For badly contaminated equipment, a hot water detergent wash may be needed prior to the first rinse.

5.2 Field Analytical Equipment Decontamination

Field analytical equipment which may come in direct contact with the sample or sample media, including, but not limited to water level meters, water/product level meters, pH or specific ion probes, specific conductivity probes, thermometers, and/or borehole geophysical probes must be

decontaminated before and after use, according to the procedures outlined in Section 5.1, unless manufacturers instructions indicate otherwise. Probes that contact water samples not used for laboratory analyses maybe rinsed with distilled water. Probes which make no direct contact (e.g., PID or FID probes) will be wiped clean with clean paper towels and distilled water.

6.0 QUALITY ASSURANCE RECORDS

Decontamination procedures are monitored through the collection of equipment rinsate samples and field blanks. Collection of these samples shall be specified in the project-specific sampling and analysis and quality assurance plans. Documentation recorded in the field logbook also shall serve as a quality assurance record.

7.0 REFERENCES

- Micham, J.T., R. Bellandi, E.C. Tifft, Jr., Spring, 1989. "Equipment Decontamination Procedures for Ground Water and Vadose Zone Monitoring Programs: Status and Prospects". In Ground Water Monitoring Review.
- U.S. EPA Office of Waste Program Enforcement, 1986, RCRA Ground Water Monitoring Technical Enforcement Guidance Document (TEGD). OSWER Directive 9950.1.
- U.S. EPA, 2001. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual, Athens, Georgia.

Appendix B

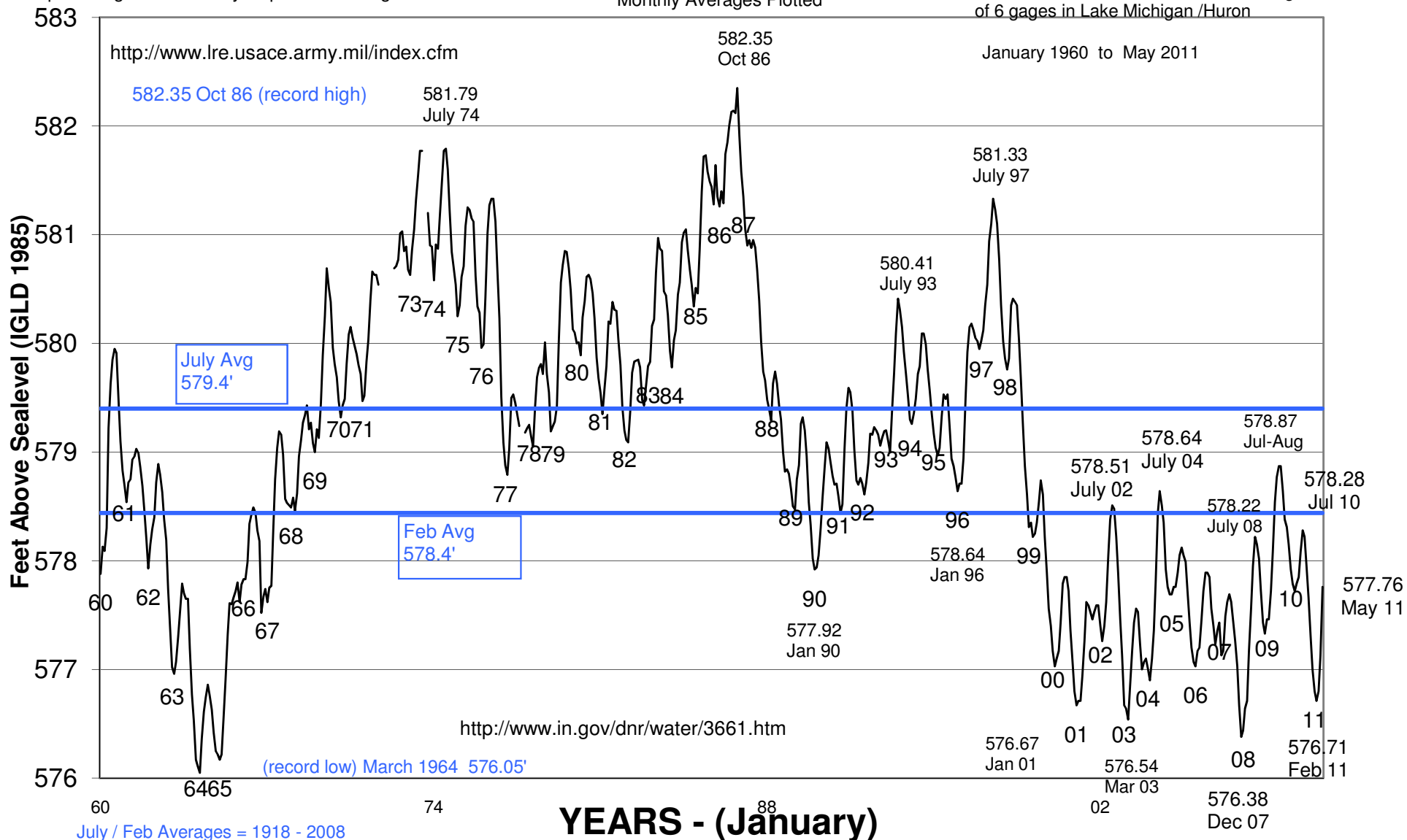
Lake Michigan Hydrographs

LAKE MICHIGAN LAKE LEVELS 1960 - 2011

Corps of Engineers Monthly Report for "Michigan - Huron"

Monthly Averages Plotted

Note: All of these numbers are the average of 6 gages in Lake Michigan /Huron

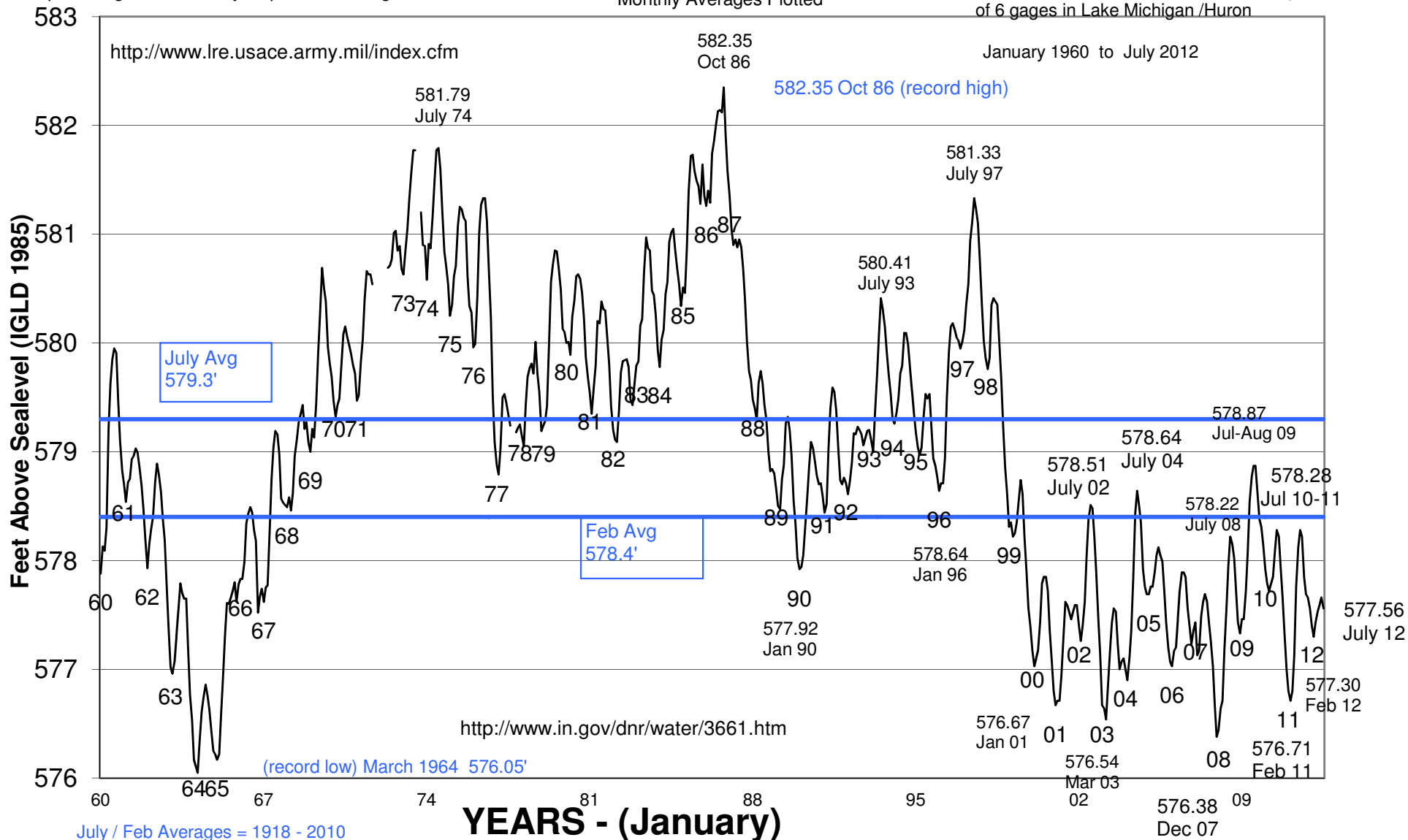


LAKE MICHIGAN LAKE LEVELS 1960 - 2012

Corps of Engineers Monthly Report for "Michigan - Huron"

Monthly Averages Plotted

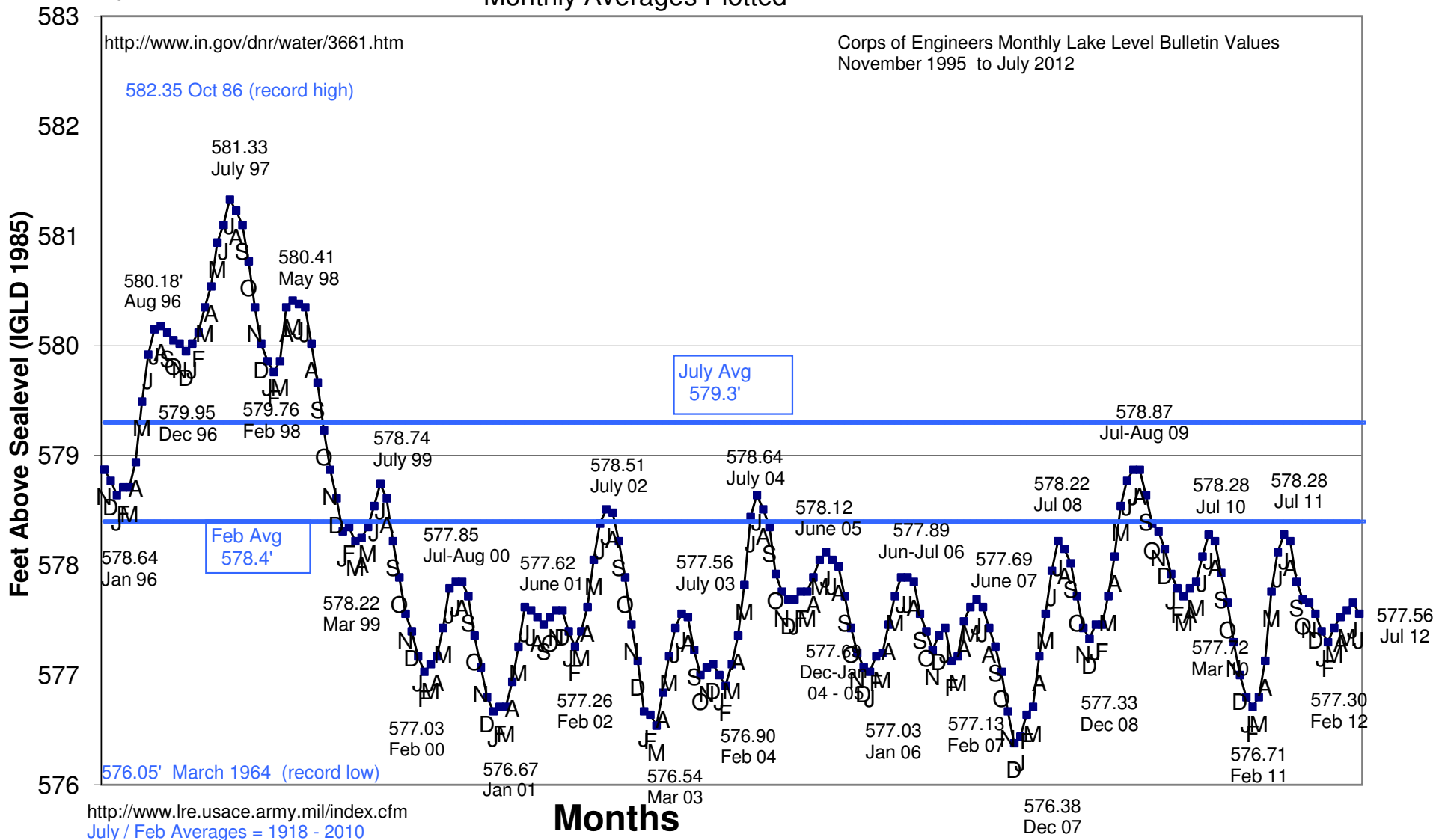
Note: All of these numbers are the average of 6 gages in Lake Michigan /Huron



Note: All of these numbers
are the average of 6 gages
in Lake Michigan and Huron.

LAKE MICHIGAN LAKE LEVEL 1996 - 2012

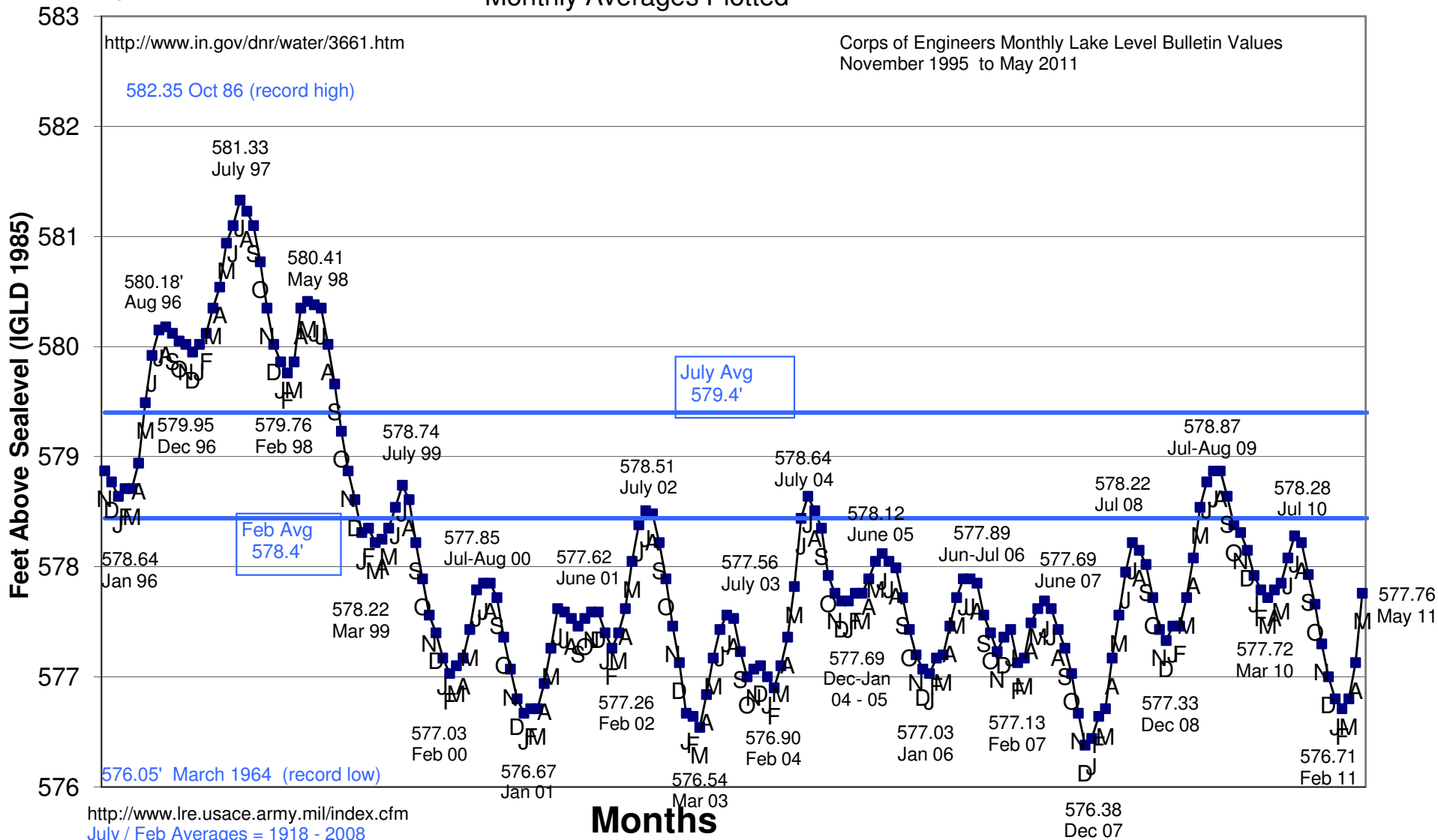
Monthly Averages Plotted



Note: All of these numbers
are the average of 6 gages
in Lake Michigan and Huron.


LAKE MICHIGAN LAKE LEVEL 1996 - 2011

Monthly Averages Plotted




Appendix C

Boring Logs and Monitoring Well Construction Diagrams

		OWNER ArcelorMittal Indiana Harbor LLC		LOG OF BORING NUMBER MW-201S	
		PROJECT NAME ArcelorMittal Indiana Harbor LLC (Clark Landfill)		ARCHITECT-ENGINEER	
SITE LOCATION 3001 Dickey Road, East Chicago, IN				Unit Dry Wt. LBS./FT. ³	PID/FID
<div style="display: flex; justify-content: space-between;"> <div style="width: 15%;"> DEPTH(FT) ELEVATION(FT) SAMPLE NO. SAMPLE TYPE SAMPLE DISTANCE RECOVERY </div> <div style="width: 60%;">DESCRIPTION OF MATERIAL</div> <div style="width: 15%;"> UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² 1 2 3 4 5 PLASTIC LIMIT % WATER CONTENT % LIQUID LIMIT % STANDARD PENETRATION BLOWS/FT. 10 20 30 40 50 </div> </div>					
SURFACE ELEVATION (ft.) +598.2					
Blind Drill					
2.0					
1 SS				0.0	22
2 SS				0.0	24
3 SS				0.0	35
8.0 Note: 1.5" layer of orange sand-sized slag at 7.4'					
4 SS				0.0	
5 SS				0.0	42
6 SS				0.0	26
7 SS				0.0	30
16.5					
8 SS				0.0	42
9 SS				0.0	
20.0 Note: Wet at 19.5'					
10 SS					5
11 SS					37
24.0					
25					
Blind Drilled to 28'					
28.0					
End of Boring				* Calibrated Penetrometer	
Boring advanced to 28.0 ft. by a hollow stem auger. Standard Penetration Tests performed with a 140 lb. hammer dropped 30 inches. Groundwater monitoring well installed at 27.0 ft. on 11/17/09. (See diagram for details.)					
The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.					
WL		BORING STARTED 11/17/09		STS OFFICE 11425 West Lake Park Drive Milwaukee, WI 53224	
WL		BORING COMPLETED 11/17/09		ENTERED BY LJE	
WL		RIG/FOREMAN /RDnP-Paul Eger		SHEET NO. 1 OF 1	
		APP'D BY LLA		STS JOB NO. 60157738	

ISG BORING LOG AECOM 60157738 CLARK_LF_ISG.GPJ STS.GDT 6/16/11

		OWNER ArcelorMittal Indiana Harbor LLC			LOG OF BORING NUMBER MW-202S		
		PROJECT NAME ArcelorMittal Indiana Harbor LLC (Clark Landfill)			ARCHITECT-ENGINEER		
SITE LOCATION 3001 Dickey Road, East Chicago, IN					<div> <div>UNCONFINED COMPRESSIVE STRENGTH</div> <div>TONS/FT.²</div> <div>1 2 3 4 5</div> </div> <div> <div>PLASTIC LIMIT %</div> <div>WATER CONTENT %</div> <div>LIQUID LIMIT %</div> </div> <div> <div>10 20 30 40 50</div> <div>10 20 30 40 50</div> </div>		
DEPTH(FT) ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL			
SURFACE ELEVATION (ft.) +601.0					Unit Dry Wt. LBS./FT. ³		
Blind Drill							
				2.0			
	1	SS		Slag Fill: Sand size - black - very dense			
				4.0			
5	2	SS		Slag Fill: Sand to Gravel size - gray to greenish - very dense			
	3	SS					
	4	SS					
10				10.0			
	5	SS		Slag Fill: Sand to Gravel size - gray to greenish - moist - very dense			
				12.0			
	6	SS		Slag Fill: Sand to Fine Gravel size - black - very dense			
15	7	SS					
	8	SS					
	9	SS					
20							
	10	SS					
	11	SS					
				24.0			
25				Blind Drilled			
30							
				31.0			
End of Boring					* Calibrated Penetrometer		
Boring advanced to 31.0 ft. by a hollow stem auger. Standard Penetration Tests performed with a 140 lb. hammer dropped 30 inches. Groundwater monitoring well installed at 30.0 ft. on 11/19/09. (See diagram for details.)							
The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.							
WL	BORING STARTED 11/19/09			STS OFFICE 11425 West Lake Park Drive Milwaukee, WI 53224			
WL	BORING COMPLETED 11/19/09			ENTERED BY LJE		SHEET NO. 1 OF 1	
WL	RIG/FOREMAN /RDnP-Paul Eger			APP'D BY LLA		STS JOB NO. 60157738	

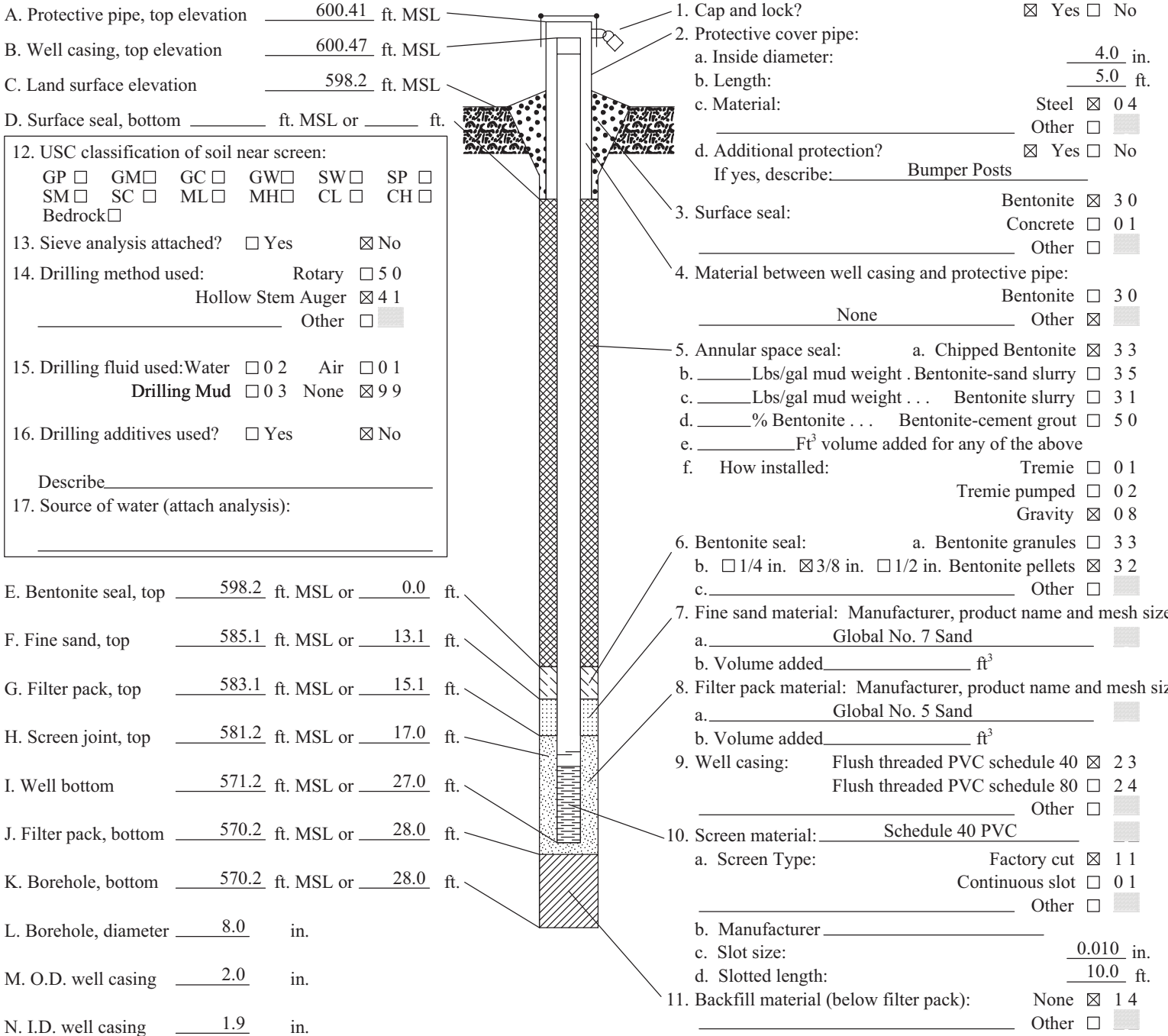
⊗ 50/5"
 ⊗ 50/5"
 ⊗ 39
 ⊗ 30
 ⊗ 79
 ⊗ 64/10"
 ⊗ 50/3"
 ⊗ 50/4"
 ⊗ 50/5"
 ⊗ 50/4"
 ⊗ 50/4"

AECOM		OWNER ArcelorMittal Indiana Harbor LLC		LOG OF BORING NUMBER MW-203S	
		PROJECT NAME ArcelorMittal Indiana Harbor LLC (Clark Landfill)		ARCHITECT-ENGINEER	
SITE LOCATION 3001 Dickey Road, East Chicago, IN				<div><div>○ UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² 1 2 3 4 5</div><div>PLASTIC LIMIT % X 10 20 30 40 50</div><div>WATER CONTENT % ● 10 20 30 40 50</div><div>LIQUID LIMIT % △ 10 20 30 40 50</div><div>STANDARD PENETRATION BLOWS/FT. ⊗ 10 20 30 40 50</div></div>	
DEPTH(FT) ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY		
⊗				SURFACE ELEVATION (ft.) +585.1	
				Blind Drill through large limestone gravel placed for cap and as slope protection - no cuttings brought up by auger.	
5					
10					
				12.0	
	1	SS		Slag Fill: Sand and Gravel - gray	
15				14.0 Note: Little recovery in spoon	
	2	SS		Slag Fill: Fine to Medium Sand size - black to gray - faint odor	
				Note: Little recovery in spoon	
	3	SS			
				18.0	
				End of Boring	* Calibrated Penetrometer
				Boring advanced to 18.0 ft. by a hollow stem auger. Standard Penetration Tests performed with a 140 lb. hammer dropped 30 inches. Groundwater monitoring well installed at 15.0 ft. on 11/19/09. (See diagram for details.)	
The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.					
WL	BORING STARTED 11/19/09		STS OFFICE 11425 West Lake Park Drive Milwaukee, WI 53224		
WL	BORING COMPLETED 11/19/09		ENTERED BY LJE SHEET NO. 1 OF 1		
WL	RIG/FOREMAN /RDnP-Paul Eger		APP'D BY LLA STS JOB NO. 60157738		

ISG BORING LOG AECOM 60157738 CLARK_LF_ISG.GPJ STS.GDT 6/16/11

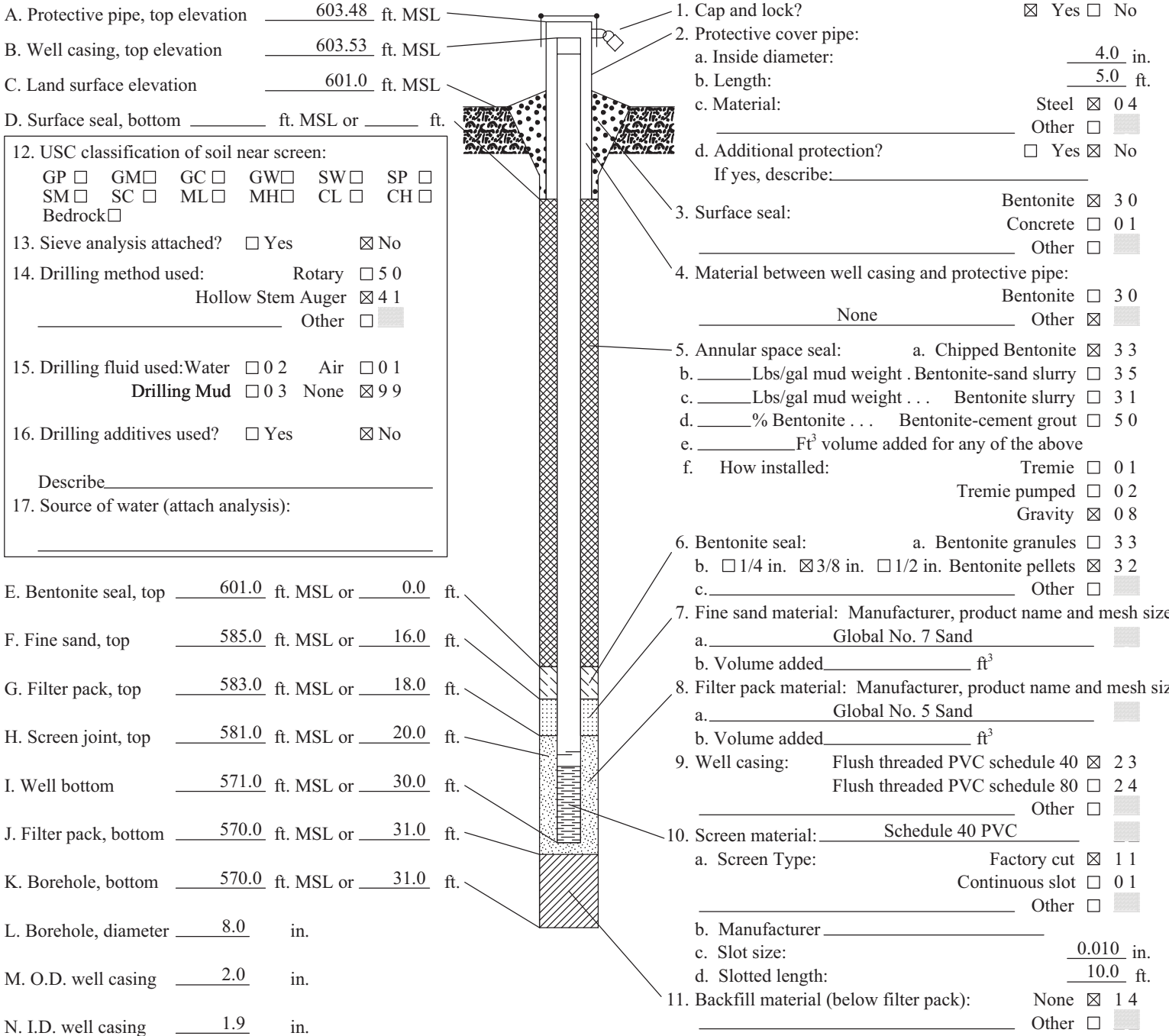
		OWNER ArcelorMittal Indiana Harbor LLC			LOG OF BORING NUMBER MW-204S						
		PROJECT NAME ArcelorMittal Indiana Harbor LLC (Clark Landfill)			ARCHITECT-ENGINEER						
SITE LOCATION 3001 Dickey Road, East Chicago, IN					Unit Dry Wt. LBS./FT. ³	PID/FID					
DEPTH(FT) ELEVATION(FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DISTANCE RECOVERY	DESCRIPTION OF MATERIAL			<div style="display: flex; justify-content: space-between; font-size: 0.8em;"> UNCONFINED COMPRESSIVE STRENGTH TONS/FT.² 1 2 3 4 5 </div> <div style="display: flex; justify-content: space-between; font-size: 0.8em;"> PLASTIC LIMIT % WATER CONTENT % LIQUID LIMIT % </div> <div style="display: flex; justify-content: space-between; font-size: 0.8em;"> 10 20 30 40 50 </div> <div style="display: flex; justify-content: space-between; font-size: 0.8em;"> STANDARD PENETRATION BLOWS/FT. </div> <div style="display: flex; justify-content: space-between; font-size: 0.8em;"> 10 20 30 40 50 </div>				
SURFACE ELEVATION (ft.) +597.3											
Blind Drill											
2.0											
Slag Fill: Sand to Gravel size - brown - moist - dense to very dense						0.0					
						0.0					
						0.0					
						0.0					
						0.0					
						0.0					
						0.0					
16.0											
Slag Fill: Sand to Gravel size - dark gray - wet - medium dense											
<i>Note: 1 or 2 larger slag chunks to small gravel size</i>											
26.0											
End of Boring					* Calibrated Penetrometer						
Boring advanced to 26.0 ft. by a hollow stem auger. Standard Penetration Tests performed with a 140 lb. hammer dropped 30 inches. Groundwater monitoring well installed at 25.0 ft. on 11/16/09. (See diagram for details.)											
The stratification lines represent the approximate boundary lines between soil types: in situ, the transition may be gradual.											
WL		BORING STARTED 11/19/09			STS OFFICE 11425 West Lake Park Drive Milwaukee, WI 53224						
WL		BORING COMPLETED 11/19/09			ENTERED BY LJE						
WL		RIG/FOREMAN /RDnP-Paul Eger			SHEET NO. 1 OF 1						
					STS JOB NO. 60157738						

<div style="display: flex; align-items: center;"> <div> <p>Facility/Project Name</p> <p>ArcelorMittal Indiana Harbor LLC (Clark Landfill)</p> </div> </div>	<p>Local Grid Location of Well</p> <p>_____ ft. <input type="checkbox"/> N. _____ ft. <input type="checkbox"/> E.</p> <p>_____ ft. <input type="checkbox"/> S. _____ ft. <input type="checkbox"/> W.</p>	<p>Well Name</p> <p>MW-201S</p>
	<p>Grid Origin Location (Check if estimated: <input type="checkbox"/>)</p> <p>Lat. _____° _____' _____" Long. _____° _____' _____" or</p> <p>St. Plane _____ ft. N, _____ ft. E. S/C/N</p>	<p>Date Well Installed</p> <p>11/17/2009</p>
	<p>Section Location</p> <p>_____ 1/4 of _____ 1/4 of Sec. _____, T. _____ N, R. _____ <input type="checkbox"/> E <input type="checkbox"/> W</p>	<p>Well Installed By: (Person's Name and Firm)</p> <p>Paul Eger</p>
		<p>RDnP</p>

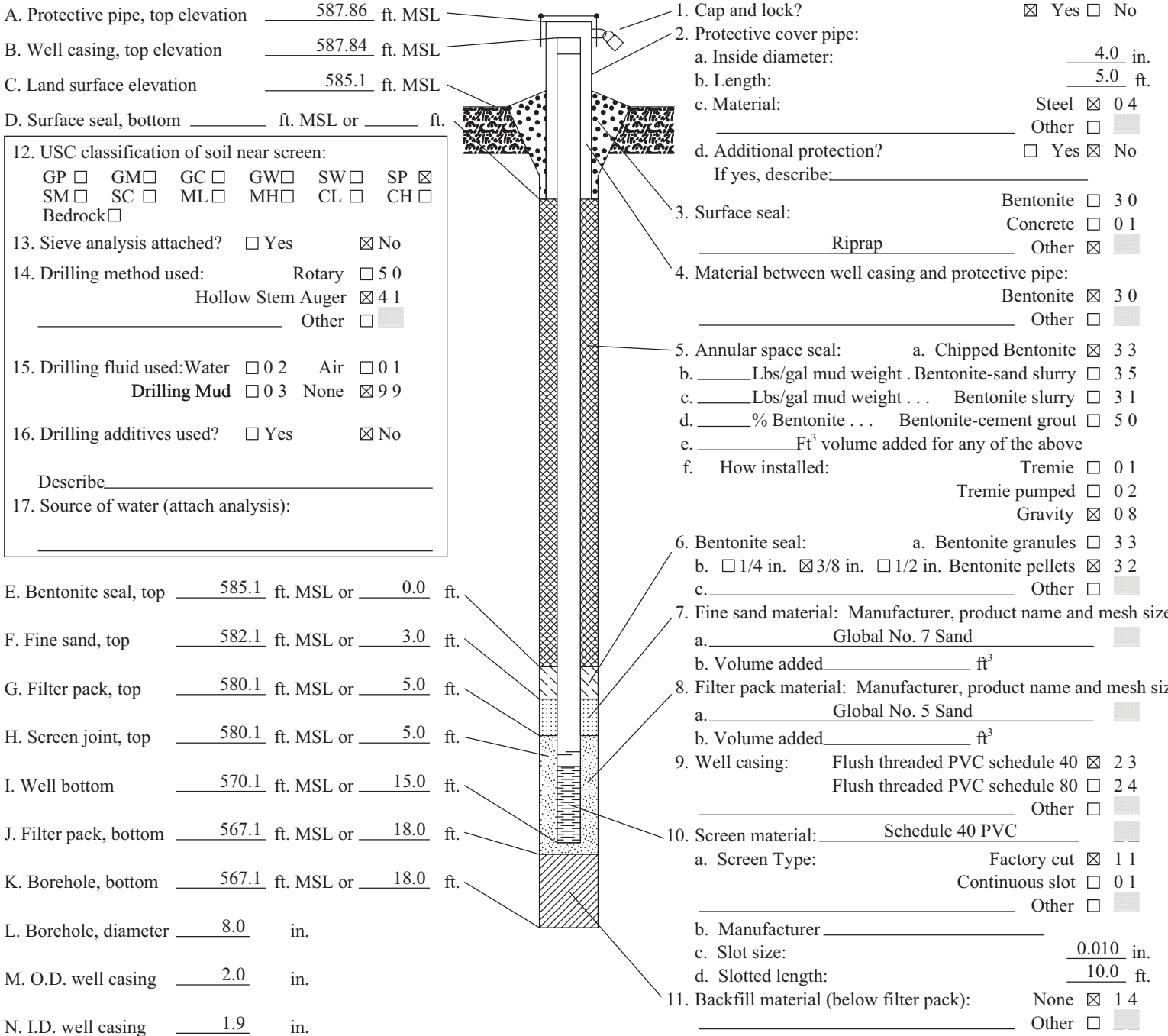


Signature	Firm	AECOM 11425 West Lake Park Drive, Milwaukee, WI 53224	Tel: 414-359-3030 Fax: 414-359-0822
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<div style="display: flex; align-items: center;"> <div> <p>Facility/Project Name</p> <p>ArcelorMittal Indiana Harbor LLC (Clark Landfill)</p> </div> </div>	<p>Local Grid Location of Well</p> <p><input type="checkbox"/> N. <input type="checkbox"/> E.</p> <p><input type="checkbox"/> S. <input type="checkbox"/> W.</p>	<p>Well Name</p> <p>MW-202S</p>
	<p>Grid Origin Location (Check if estimated: <input type="checkbox"/>)</p> <p>Lat. <input type="text"/> ° <input type="text"/> ' <input type="text"/> " Long. <input type="text"/> ° <input type="text"/> ' <input type="text"/> " or</p> <p>St. Plane <input type="text"/> ft. N, <input type="text"/> ft. E. S/C/N</p>	<p>Date Well Installed</p> <p>11/19/2009</p>
	<p>Section Location</p> <p><input type="checkbox"/> E. <input type="checkbox"/> W.</p> <p><input type="text"/> 1/4 of <input type="text"/> 1/4 of Sec. <input type="text"/> , T. <input type="text"/> N, R. <input type="text"/> </p>	<p>Well Installed By: (Person's Name and Firm)</p> <p>Paul Eger</p>
		<p>RDnP</p>

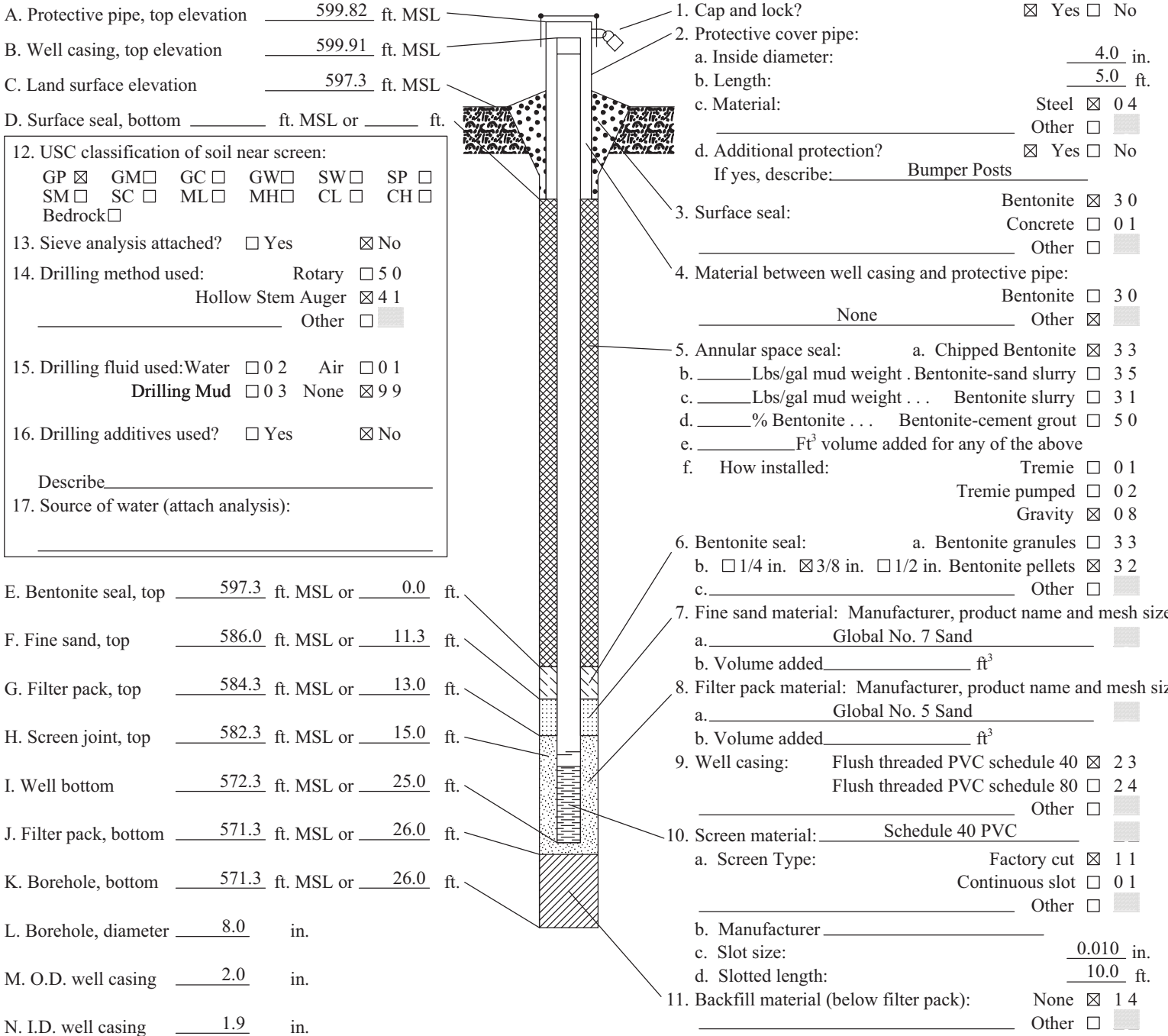


Signature	Firm	AECOM 11425 West Lake Park Drive, Milwaukee, WI 53224	Tel: 414-359-3030 Fax: 414-359-0822
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Signature	Firm	AECOM 11425 West Lake Park Drive, Milwaukee, WI 53224	Tel: 414-359-3030 Fax: 414-359-0822
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<div style="display: flex; align-items: center;"> <div> <p>Facility/Project Name</p> <p>ArcelorMittal Indiana Harbor LLC (Clark Landfill)</p> </div> </div>	<p>Local Grid Location of Well</p> <p>_____ ft. <input type="checkbox"/> N. _____ ft. <input type="checkbox"/> E.</p> <p>_____ ft. <input type="checkbox"/> S. _____ ft. <input type="checkbox"/> W.</p>	<p>Well Name</p> <p>MW-204S</p>
	<p>Grid Origin Location (Check if estimated: <input type="checkbox"/>)</p> <p>Lat. _____° _____' _____" Long. _____° _____' _____" or</p> <p>St. Plane _____ ft. N, _____ ft. E. S/C/N</p>	<p>Date Well Installed</p> <p>11/16/2009</p>
	<p>Section Location</p> <p>_____ 1/4 of _____ 1/4 of Sec. _____, T. _____ N, R. _____ <input type="checkbox"/> E <input type="checkbox"/> W</p>	<p>Well Installed By: (Person's Name and Firm)</p> <p>Paul Eger</p>
		<p>RDnP</p>



Signature	Firm	AECOM 11425 West Lake Park Drive, Milwaukee, WI 53224	Tel: 414-359-3030 Fax: 414-359-0822
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Appendix D

Well Development Field Sheets

Well Development Record



STS Consultants, Ltd.
11425 West Lake Park Drive
Milwaukee, Wisconsin 53224

Site Name: Clark Landfill

Well ID Number: MW-207 S

Date of Completion: 11/20 & 21 / 09

STS Job Number: _____

Start Time: 13:30 11/20

End Time: 14:30 11/20

13:30 11/24

14:55 11/24

Water color at start of development:

black

Water color at end of development:

clear

Amount of water removed during development: about 20 gallons 11/20

Contained water? ☒ Yes ☐ No pumped 48 gallons 11/24

If not contained, where water disposed? _____

Well Development Methods:

☒ Surged with bailer and bailed

☐ Surged with bailer and pumped

☐ Surged with block and bailed

☐ Surged with block and pumped

☐ Surged with block, bailed & pumped

☐ Compressed Air

☐ Bailed only

☐ Pumped only

☒ Pumped slowly

☐ Other _____

Equipment Used

☒ PVC bailer

☐ Surge block

☐ Well wizard

☒ Whale pumps

☐ Bean or Moino pump (on drill rig)

Notes:

pump failed, came back on 11/24

WELL DEVELOPMENT FIELD RECORD

Job Name Clark Landfill Job No. _____ Well No. MW-2015

Developed By Josh Rowe Date of Install. ~~11/17/09~~ 11/20/09 Sheet _____ of _____

Started Devel. 11/20/09 / 13:30 Completed Devel. 11/20/09 / 14:30

W.L. Before Devel. 11/20/09 / 13:30 / 20.50 After Devel. 11/20/09 / 14:30 / 20.50

Well Depth: Before Devel. 27' After Devel. _____ Well Dia. (in.) 2

Standing Water Column (ft.) _____ Standing Well Volume _____ gal.

Screen Length 10' Drilling Water Loss _____ gal.

DATE / TIME	VOLUME REMOVED (Gallons)	FIELD PARAMETERS					REMARKS
		SPEC. COND. (umhos/cm)	TEMP. (C°)	pH (s.u.)	TURB Other	Cap	
<u>11/24/09 14:38</u>		<u>.475</u>	<u>19.7</u>	<u>9.87</u>	<u>340</u>	<u>253</u>	
<u>14:41</u>		<u>.464</u>	<u>19.9</u>	<u>9.87</u>	<u>57</u>	<u>-261</u>	
<u>14:44</u>		<u>.459</u>	<u>20.0</u>	<u>9.77</u>	<u>17</u>	<u>-258</u>	
<u>14:46</u>		<u>.456</u>	<u>20.0</u>	<u>9.73</u>	<u>11</u>	<u>-260</u>	
<u>14:49</u>		<u>.454</u>	<u>20.0</u>	<u>9.70</u>	<u>8</u>	<u>-261</u>	
<u>14:52</u>		<u>.453</u>	<u>20.0</u>	<u>9.69</u>	<u>7</u>	<u>-261</u>	
<u>14:55</u>	<u>48</u>	<u>.453</u>	<u>20.0</u>	<u>9.69</u>	<u>6</u>	<u>-261</u>	
<u>11/20/09 17:30</u>	<u>20</u>						
	<u>68</u>	= TOTAL VOLUME REMOVED (Gallons)					

Development Method: _____

Notes:

Well Development Record



STS Consultants, Ltd.
11425 West Lake Park Drive
Milwaukee, Wisconsin 53224

Site Name: Clark Landfill Well ID Number: MW-2025

Date of Completion: 11/20 & 24/09 STS Job Number: _____

Start Time: 10:00 11/20 End Time: 11:35 11/20

Water color at start of development: blackish gray Water color at end of development: clear

Amount of water removed during development: bailed 10 gallons 11/20

Contained water? ☒ Yes ☐ No pumped 48 gallons 11/24

If not contained, where water disposed? _____

Well Development Methods:

<input checked="" type="checkbox"/> Surged with bailer and bailed	<input type="checkbox"/> Surged with bailer and pumped
<input type="checkbox"/> Surged with block and bailed	<input type="checkbox"/> Surged with block and pumped
<input type="checkbox"/> Surged with block, bailed & pumped	<input type="checkbox"/> Compressed Air
<input type="checkbox"/> Bailed only	<input type="checkbox"/> Pumped only
<input checked="" type="checkbox"/> Pumped slowly	<input type="checkbox"/> Other _____

Equipment Used

<input checked="" type="checkbox"/> PVC bailer	<input type="checkbox"/> Surge block
<input type="checkbox"/> Well wizard	<input checked="" type="checkbox"/> Whale pumps
<input type="checkbox"/> Bean or Moino pump (on drill rig)	

Notes: pump failed, came back on 11/24

WELL DEVELOPMENT FIELD RECORD

Job Name Clark Landfill Job No. _____ Well No. MW-2025

Developed By Josh Rowe Date of Install. 11/19/09 ~~11/20/09~~ Sheet _____ of _____

Started Devel. 11/20/09 / 10:00 Completed Devel. 11/20/09 / 11:35

W.L. Before Devel. 11/20/09 / 10:06 / 24.07 After Devel. 11/20/09 / 11:35 / 24.00

Well Depth: Before Devel. 30' After Devel. _____ Well Dia. (in.) 2

Standing Water Column (ft.) _____ Standing Well Volume _____ gal.

Screen Length 10' Drilling Water Loss _____ gal.

DATE / TIME	VOLUME REMOVED (Gallons)	FIELD PARAMETERS					REMARKS
		SPEC. COND. (umhos/cm)	TEMP. (C°)	pH (s.u.)	TURB Other	CRP	
11/24/09 11:13		2.99	17.7	11.7	—	-201	
11:16		2.99	17.9	11.59	—	-264	
11:19		3.01	18.0	11.52	60	-270	
11:21		3.00	18.1	11.52	47	-245	
11:24		2.98	18.1	11.51	10	-257	
11:27		2.98	18.1	11.51	9	-260	
11:30	48	2.98	18.1	11.51	8	-262	
11/20/09 11:35	10						
	58	= TOTAL VOLUME REMOVED (Gallons)					

Development Method: _____

Notes:

Well Development Record



STS Consultants, Ltd.
11425 West Lake Park Drive
Milwaukee, Wisconsin 53224

Site Name: Clark Landfill

Well ID Number: MW-2035

Date of Completion: 11/20 & 24/09

STS Job Number: _____

Start Time: 12:20 11/20

End Time: 13:16 11/20

Water color at start of development: blackish gray

Water color at end of development: clear

Amount of water removed during development:

bailed 20 gallons 11/20

Contained water? ☒ Yes

☐ No

pumped 44 gallons 11/24

If not contained, where water disposed? _____

Well Development Methods:

☒ Surged with bailer and bailed

☐ Surged with bailer and pumped

☐ Surged with block and bailed

☐ Surged with block and pumped

☐ Surged with block, bailed & pumped

☐ Compressed Air

☐ Bailed only

☐ Pumped only

☒ Pumped slowly

☐ Other _____

Equipment Used

☒ PVC bailer

☐ Surge block

☐ Well wizard

☒ Whale pumps

☐ Bean or Moino pump (on drill rig)

Notes:

pump failed, came back on 11/24

WELL DEVELOPMENT FIELD RECORD

Job Name Clark Landfill Job No. _____ Well No. MW-203 S
 Developed By Josh Rowe Date of Install. 11/19/09 ~~11/20/09~~ Sheet _____ of _____
 Started Devel. 11/20/09 / 12:20 Completed Devel. 11/20/09 / 13:16
 DATE TIME DATE TIME
 11/24/09 11:55 11/24/09 12:52
 W.L. Before Devel. 11/20/09 / 12:20 / 8.70 After Devel. 11/20/09 / 13:16 / 8.66
 DATE TIME DEPTH DATE TIME DEPTH
 11/24/09 11:55 8.65 11/24/09 12:52 8.55
 Well Depth: Before Devel. 15' After Devel. 15' Well Dia. (in.) 2
 Standing Water Column (ft.) _____ Standing Well Volume _____ gal.
 Screen Length 10 ft Drilling Water Loss _____ gal.

DATE / TIME	VOLUME REMOVED (Gallons)	FIELD PARAMETERS					REMARKS
		SPEC. COND. (umhos/cm)	TEMP. (C°)	pH (s.u.)	TURB Other	CRP	
11/20/09 13:16	20	1.92	18.9	12.27	66	-269	
11/24/09 12:35		2.02	20.1	11.16	76	-306	
12:38		2.53	20.3	11.44	15	-316	
12:41		2.52	20.4	11.43	6	-320	
12:43		2.52	20.4	11.43	5	-323	
12:46	44	2.52	20.4	11.42	4	-326	
	64	= TOTAL VOLUME REMOVED (Gallons)					

Development Method: _____

Notes:

Well Development Record



STS Consultants, Ltd.
11425 West Lake Park Drive
Milwaukee, Wisconsin 53224

Site Name: Clark Landfill

Well ID Number: MW-204 S

Date of Completion: 11/20/09

STS Job Number: _____

Start Time: 9:45 8:45

End Time: 9:25

Water color at start of development: gray

Water color at end of development: clear

Amount of water removed during development: 24 gallons

Contained water? ☒ Yes ☐ No

If not contained, where water disposed? _____

Well Development Methods:

☒ Surged with bailer and bailed

☐ Surged with block and bailed

☐ Surged with block, bailed & pumped

☐ Bailed only

☒ Pumped slowly

☐ Surged with bailer and pumped

☐ Surged with block and pumped

☐ Compressed Air

☐ Pumped only

☐ Other _____

Equipment Used

☐ PVC bailer

☐ Well wizard

☐ Bean or Moino pump (on drill rig)

☐ Surge block

☒ Whale pumps

Notes: _____

WELL DEVELOPMENT FIELD RECORD

Job Name Clark Landfill Job No. _____ Well No. MW-2045
 Developed By Josh Rowe Date of Install. 11/16/09 ~~11/20/09~~ Sheet _____ of _____
 Started Devel. 11/20/09 / 8:45 Completed Devel. 11/20/09 / 9:25
DATE TIME DATE TIME
 W.L. Before Devel. 11/20/09 / 8:45 / 20.40 After Devel. 11/20/09 / 9:25 / 20.40
DATE TIME DEPTH DATE TIME DEPTH
 Well Depth: Before Devel. 30' After Devel. _____ Well Dia. (in.) 2
 Standing Water Column (ft.) _____ Standing Well Volume _____ gal.
 Screen Length 10' Drilling Water Loss _____ gal.

DATE / TIME	VOLUME REMOVED (Gallons)	FIELD PARAMETERS					REMARKS
		SPEC. COND. (umhos/cm)	TEMP. (C°)	pH (s.u.)	Other ^{TURB}	^{CRP}	
11/20/09 9:25		1.58	16.9	10.86	180	-259	
9:28		1.65	17.4	11.31	30	-284	
9:33		1.65	17.7	11.94	13	-311	
9:36		1.65	17.9	12.07	10	-312	
9:39		1.66	17.9	12.13	6	-308	
9:42		1.66	17.9	12.16	5	-318	
9:45	21	1.66	18.0	12.15	4	-328	
	21	= TOTAL VOLUME REMOVED (Gallons)					

Development Method: _____

Notes:

Field Well Sampling Sheet

Fill out the entire form. If it does not apply, mark N/A.

Project Name: Clark Landfill Project No. _____

Location: _____ Tester: _____

Well Number: MW-2635 Date Sampled: 11/20/09

Previous Well Sampled: WL pre-purge 20.50 @ 13:30

AECOM 11/24
20.50 @ 13:30

GENERAL CONDITIONS:

Surface Seal:	<input type="checkbox"/> Ok	<input type="checkbox"/> Damaged	<input type="checkbox"/> Missing:	Yes	No
Protector Pipe:	<input type="checkbox"/> Ok	<input type="checkbox"/> Damaged	<input type="checkbox"/> Missing:	Yes	No
Well Cap:	<input type="checkbox"/> Ok	<input type="checkbox"/> Damaged	<input type="checkbox"/> Missing:	Yes	No
Ambient Temperature: _____ °F	<input type="checkbox"/> Clear	<input type="checkbox"/> Cloudy	<input type="checkbox"/> Rain		

WELL DATA:

Measuring Device: _____

Stick Up or Down: 11/20 11/24 (from Ground Surface)

WL after Depth to Water: 20.50 @ 14:30 20.48 @ 14:55 (from TPVC)

Depth to Bottom: _____ (from TPVC)

Length of Water: _____

Free Product Observed: ☐ Yes ☐ No Thickness: _____

PURGING/SAMPLING:

Well Purging Calculations: Amount to purge = 0.163 gallons/foot times height of water column in feet for one well volume

Purging Device: _____ Sampling Device: _____

Volume Required: _____ ☐ See back of page for field readings during purge

Volume Purged: _____

Could Well Bail Dry? ☐ Yes ☐ No

Purging - Time Start: _____ Time Ended: _____

Decon Method: _____

IN-SITU TESTING:

Turbidity: ☐ Turbid ☐ Opaque

Odor: _____

Color: _____

pH @ _____ degrees C

Uncorrected Conductivity _____ X

Water Temp. (from Cond.) _____

Comments: took out 20 gallons w/ bailer

SAMPLES COLLECTED

Vocs -	<input type="checkbox"/>	Cyanide	<input type="checkbox"/>
Metals -	<input type="checkbox"/>	Hexchrome	<input type="checkbox"/>
SVOC	<input type="checkbox"/>	Alkalinity	<input type="checkbox"/>
TOC	<input type="checkbox"/>	Chloride	<input type="checkbox"/>
Sulfide	<input type="checkbox"/>	Ammonia	<input type="checkbox"/>
Phenolics	<input type="checkbox"/>	COD	<input type="checkbox"/>

Well Purging Log

Date 11-24-09

[illegible]

Field Well Sampling Sheet

Fill out the entire form. If it does not apply, mark N/A.

Development

Project Name:

Clark Landfill

Project No. _____

Location:

GW-204 S

Tester: _____

Well Number:

Clark Landfill

Date Sampled:

10/20/09

AECOM

Previous Well Sampled:

Depth to water before Development:

20.40 @ 8:45

GENERAL CONDITIONS:

Surface Seal:	<input type="checkbox"/> Ok	<input type="checkbox"/> Damaged	<input type="checkbox"/> Missing:	Yes	No
Protector Pipe:	<input type="checkbox"/> Ok	<input type="checkbox"/> Damaged	<input type="checkbox"/> Missing:	Yes	No
Well Cap:	<input type="checkbox"/> Ok	<input type="checkbox"/> Damaged	<input type="checkbox"/> Missing:	Yes	No
Ambient Temperature:	____ °F	<input type="checkbox"/> Clear	<input type="checkbox"/> Cloudy	<input type="checkbox"/> Rain	

WELL DATA:

Measuring Device: _____

Stick Up or Down: _____

(from Ground Surface)

Depth to Water:

20.40 @ 9:25

(from TPVC)

Depth to Bottom: _____

(from TPVC)

Length of Water: _____

Free Product Observed:

☐

Yes

☐

No

Thickness: _____

PURGING/SAMPLING:

Well Purging Calculations:

Amount to purge = 0.163 gallons/foot times height of water column in feet for one well volume

Purging Device: _____

Sampling Device: _____

Volume Required: _____

☐

See back of page for field readings during purge

Volume Purged: _____

Could Well Bail Dry?

☐

Yes

☐

No

Purging - Time Start: _____

Time Ended: _____

Decon Method: _____

IN-SITU TESTING:

Turbidity: ☐ Turbid ☐ Opaque

Odor: _____

Color: _____

pH @ _____ degrees C

Uncorrected Conductivity

X

Water Temp. (from Cond.) _____

SAMPLES COLLECTED

Vocs -

Metals -

SVOC

TOC

Sulfide

Phenolics

Cyanide

Hexchrome

Alkalinity

Chloride

Ammonia

COD

cal. PH 3.97

cond. 4.50 ns/cm

turb. 0

temp. 10.9°C

7.0 pH 6.95 @ 10.3°C

Comments:

Surged + purge d X 30 minutes

Pumped till parameters stabilized - see back

start at 8:45 end at 9:45

Well Purging Log

Date 11/20/09

18 gallons removed

[illegible]

Field Well Sampling Sheet

Fill out the entire form. If it does not apply, mark N/A.

Project Name: Clark Landfill Project No. _____
 Location: _____ Tester: _____
 Well Number: MW-2025 Date Sampled: 10/20/09
 Previous Well Sampled: Depth to water before development: 24.07 @ 10:00 **AECOM** 10/24
 24.00 @ 10:15

GENERAL CONDITIONS:

Surface Seal: ☐ Ok ☐ Damaged ☐ Missing: Yes No
 Protector Pipe: ☐ Ok ☐ Damaged ☐ Missing: Yes No
 Well Cap: ☐ Ok ☐ Damaged ☐ Missing: Yes No
 Ambient Temperature: _____ °F ☐ Clear ☐ Cloudy ☐ Rain
 If Missing Replaced?

WELL DATA:

Measuring Device: _____
 Stick Up or Down: _____ (from Ground Surface)
 Depth to Water: 24.00 @ 11:35 (from TPVC)
 Depth to Bottom: _____ (from TPVC)
 Length of Water: _____
 Free Product Observed: ☐ Yes ☐ No Thickness: _____
after development *purging stat 10:27*

PURGING/SAMPLING:

Well Purging Calculations: Amount to purge = 0.163 gallons/foot times height of water column in feet for one well volume

Purging Device: _____ Sampling Device: _____
 Volume Required: _____ ☐ See back of page for field readings during purge
 Volume Purged: _____
 Could Well Bail Dry? ☐ Yes ☐ No
 Purging - Time Start: _____ Time Ended: _____
 Decon Method: _____

IN-SITU TESTING:

Turbidity: ☐ Turbid ☐ Opaque
 Odor: _____
 Color: _____
 pH @ _____ degrees C
 Uncorrected Conductivity _____ X
 Water Temp. (from Cond.) _____

SAMPLES COLLECTED

Vocs - ☐ Cyanide ☐
 Metals - ☐ Hexchrome ☐
 SVOC ☐ Alkalinity ☐
 TOC ☐ Chloride ☐
 Sulfide ☐ Ammonia ☐
 Phenolics ☐ COD ☐

pH 3.96
 Cond. 4.50 mS/cm
 turb 0
 temp 11.0°C
 pH 7 @ 9.8°C

Comments: pump failed collected 10 gallons w/ failer

needs more pump development

10/24-Pumped 48 gallons

Well Purging Log

Date 10/24

[illegible]

Field Well Sampling Sheet

Fill out the entire form. If it does not apply, mark N/A.

Project Name: Clark Landfill Project No. _____

Location: _____ Tester: _____

Well Number: MW- 2035 Date Sampled: 11/20/09

Previous Well Sampled: WL before purge: 8.70 @ 12:20

AECOM 11/24

8.65 @ 11:55

GENERAL CONDITIONS:

Surface Seal:	<input type="checkbox"/> Ok	<input type="checkbox"/> Damaged	<input type="checkbox"/> Missing:	Yes	No
Protector Pipe:	<input type="checkbox"/> Ok	<input type="checkbox"/> Damaged	<input type="checkbox"/> Missing:	Yes	No
Well Cap:	<input type="checkbox"/> Ok	<input type="checkbox"/> Damaged	<input type="checkbox"/> Missing:	Yes	No
Ambient Temperature: _____ °F	<input type="checkbox"/> Clear	<input type="checkbox"/> Cloudy	<input type="checkbox"/> Rain		

WELL DATA:

Measuring Device: _____

Stick Up or Down: 11/20 11/24 (from Ground Surface)

WL after Depth to Water: 8.66 @ 13:16 8.55 @ 12:52 (from TPVC)

Depth to Bottom: _____ (from TPVC)

Length of Water: _____

Free Product Observed: ☐ Yes ☐ No Thickness: _____

PURGING/SAMPLING:

Well Purging Calculations: Amount to purge = 0.163 gallons/foot times height of water column in feet for one well volume

Purging Device: _____

Sampling Device: _____

Volume Required: _____

☐ See back of page for field readings during purge

Volume Purged: _____

Could Well Bail Dry? ☐ Yes ☐ No

Purging - Time Start: _____ Time Ended: _____

Decon Method: _____

IN-SITU TESTING:

Turbidity: ☐ Turbid ☐ Opaque

Odor: _____

Color: _____

pH @ _____ degrees C

Uncorrected Conductivity _____ X

Water Temp. (from Cond.) _____

Comments: bailed out 20 gallons, still needs pump development

SAMPLES COLLECTED

Vocs -	<input type="checkbox"/>	Cyanide	<input type="checkbox"/>
Metals -	<input type="checkbox"/>	Hexchrome	<input type="checkbox"/>
SVOC	<input type="checkbox"/>	Alkalinity	<input type="checkbox"/>
TOC	<input type="checkbox"/>	Chloride	<input type="checkbox"/>
Sulfide	<input type="checkbox"/>	Ammonia	<input type="checkbox"/>
Phenolics	<input type="checkbox"/>	COD	<input type="checkbox"/>

11/24/ Pumped 44 gallons

Well Purging Log

Date 10/20/09

[illegible]

Appendix E

Hydraulic Conductivity Testing- Data and Calculations

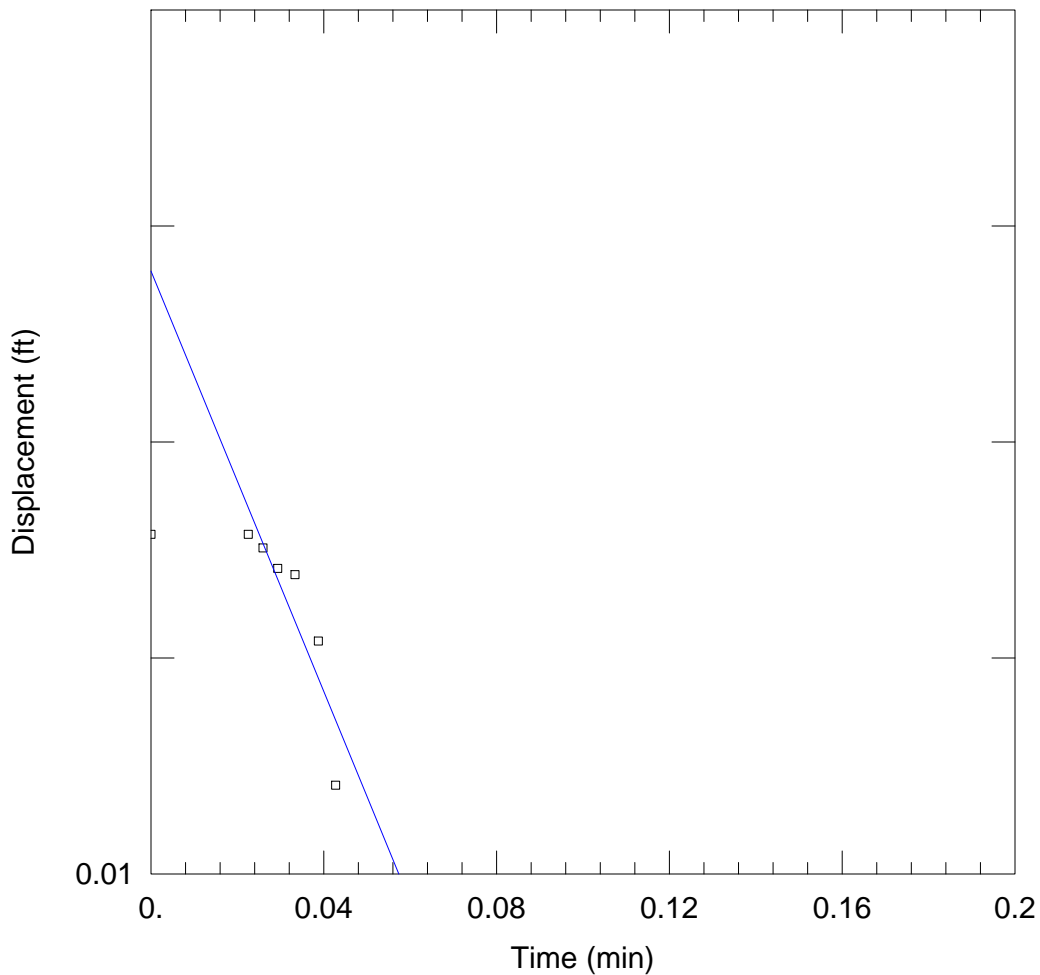
CLark Landfill

Log Name MW-201S_1

Create Date 2/12/2010 11:45

WL Initial 20.43 (ft)

Elapsed Time (Min)	Depth To Water (ft)
0	20.43
0.022533333	20.803347
0.02595	20.752985
0.02935	20.689644
0.03335	20.672997
0.038766667	20.549723
0.04275	20.455746
0.047	20.424318
0.050433333	20.405308
0.054183333	20.40077
0.05835	20.409592
0.062516667	20.421064
0.066683333	20.431087
0.07085	20.433285
0.075016667	20.435122
0.079183333	20.432514
0.08335	20.434563
0.087516667	20.430172
0.091683333	20.431871
0.09585	20.431999
0.100016667	20.433159
0.106016667	20.435774
0.112016667	20.430565
0.119016667	20.43096
0.126	20.42458



MITTAL - CLARK LANDFILL

Data Set: C:\Documents and Settings\schmidt\ Desktop\Mittal Clark Landfill\MW-201S_1.aqt
 Date: 02/24/10 Time: 11:53:56

PROJECT INFORMATION

Company: AECOM
 Client: Mittal
 Project: 60139029 Task 8000
 Test Location: East Chicago, IN
 Test Well: MW-201S Test 1
 Test Date: 2/12/2010

AQUIFER DATA

Saturated Thickness: 6.57 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-201S_T1)

Initial Displacement: 0.3733 ft Casing Radius: 0.08333 ft
 Wellbore Radius: 0.3333 ft Well Skin Radius: 0.3333 ft
 Screen Length: 10. ft Total Well Penetration Depth: 6.57 ft
 Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
 K = 0.25 cm/sec y_0 = 6.18 ft

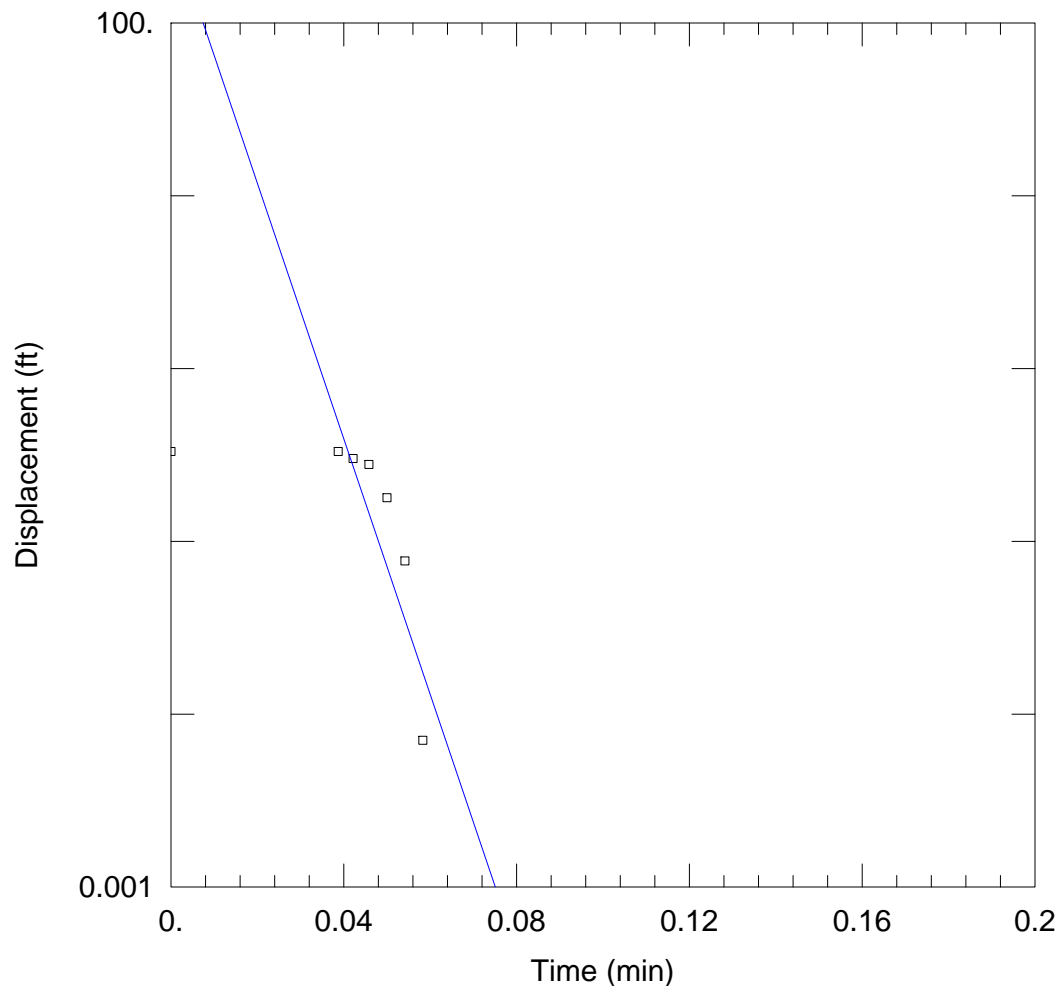
CLark Landfill

Log Name MW-201S_2

Create Date 2/12/2010 11:54

WL Initial 20.43 (ft)

Elapsed Time (Min)	Depth To Water (ft)
0	20.43
0.038716667	20.760952
0.04215	20.731697
0.045833333	20.708321
0.05	20.608692
0.054166667	20.506973
0.058333333	20.437052
0.0625	20.40251
0.066666667	20.394979
0.071466667	20.409412
0.075	20.423822
0.079166667	20.430481
0.083333333	20.42057



MITTAL - CLARK LANDFILL

Data Set: C:\Documents and Settings\schmidt\ Desktop\Mittal Clark Landfill\MW-201S_2.aqt

Date: 02/24/10

Time: 11:59:46

PROJECT INFORMATION

Company: AECOM

Client: Mittal

Project: 60139029 Task 8000

Test Location: East Chicago, IN

Test Well: MW-201S Test 2

Test Date: 2/12/2010

AQUIFER DATA

Saturated Thickness: 6.57 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (MW-201S_T2)

Initial Displacement: 0.331 ft

Wellbore Radius: 0.3333 ft

Screen Length: 10. ft

Gravel Pack Porosity: 0.3

Casing Radius: 0.08333 ft

Well Skin Radius: 0.3333 ft

Total Well Penetration Depth: 6.57 ft

SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 0.38$ cm/sec

$y_0 = 355.6$ ft

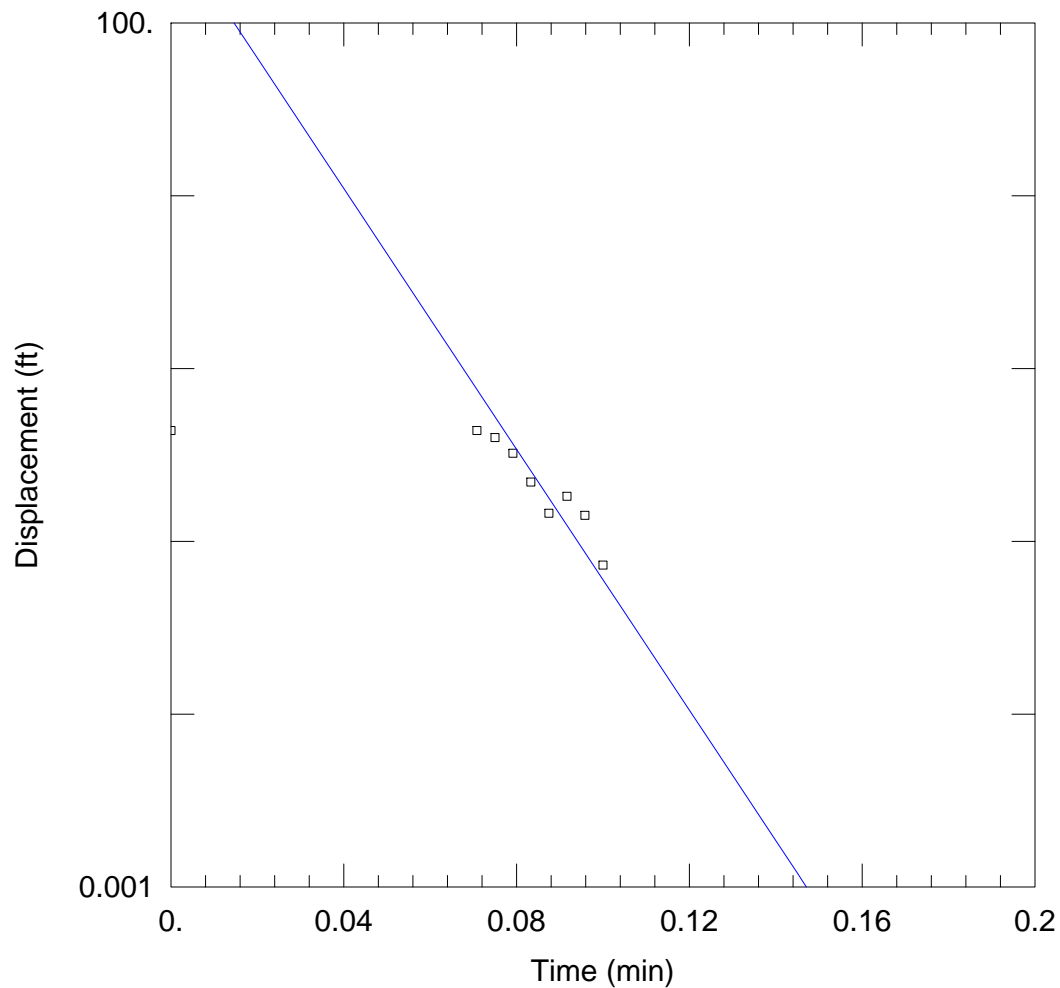
CLark Landfill

Log Name MW-201S_3

Create Date 2/12/2010 12:00

WL Initial 20.43 (ft)

Elapsed Time (Min)	Depth To Water (ft)
0	20.43
0.070833333	20.86776
0.075	20.82818
0.079166667	20.753378
0.083333333	20.65035
0.0875	20.575252
0.091666667	20.612388
0.095833333	20.571493
0.1	20.502804
0.106	20.426868
0.112	20.402832
0.119	20.415405
0.126	20.429573
0.133	20.430353



MITTAL - CLARK LANDFILL

Data Set: C:\Documents and Settings\schmidt\ Desktop\Mittal Clark Landfill\MW-201S_3.aqt

Date: 02/24/10

Time: 12:03:33

PROJECT INFORMATION

Company: AECOM

Client: Mittal

Project: 60139029 Task 8000

Test Location: East Chicago, IN

Test Well: MW-201S Test 3

Test Date: 2/12/2010

AQUIFER DATA

Saturated Thickness: 6.57 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (MW-201S_T3)

Initial Displacement: 0.4378 ft

Wellbore Radius: 0.3333 ft

Screen Length: 10. ft

Gravel Pack Porosity: 0.3

Casing Radius: 0.08333 ft

Well Skin Radius: 0.3333 ft

Total Well Penetration Depth: 6.57 ft

SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 0.1939$ cm/sec

$y_0 = 355.6$ ft

CLark Landfill

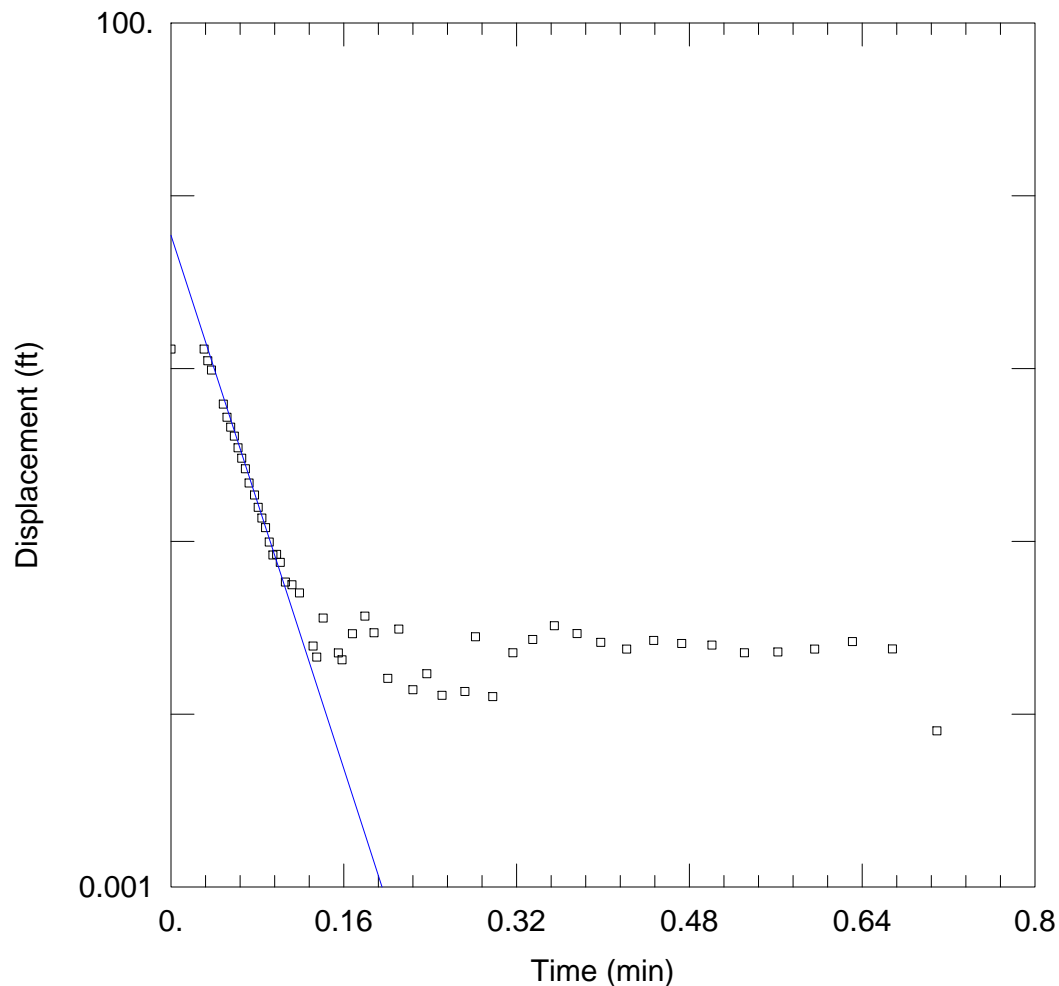
Log Name MW-202S_1

Create Date 2/12/2010 12:20

WL Intial 24.24 (ft)

Elapsed Time (Min)	Depth To Water (ft)
0	24.24
0.030783333	25.535213
0.0342	25.348564
0.0376	25.219759
0.0485	24.861967
0.051916667	24.761965
0.055333333	24.698187
0.058733333	24.646639
0.062133333	24.587685
0.06555	24.542543
0.069	24.503132
0.0724	24.457426
0.077416667	24.42524
0.080816667	24.397425
0.084216667	24.376328
0.087616667	24.360029
0.091033333	24.339012
0.094433333	24.323383
0.097833333	24.324085
0.101266667	24.315493
0.106	24.298153
0.112016667	24.296021
0.119	24.290268
0.1316	24.264757
0.135033333	24.261404
0.141016667	24.275967
0.155	24.262611
0.15845	24.260609
0.168	24.269167
0.179566667	24.276913
0.188	24.26956
0.200766667	24.256109
0.211	24.271029
0.224	24.253845
0.237	24.257147
0.251	24.252859
0.27225	24.253532
0.282	24.268005
0.298	24.252642
0.3166	24.262669
0.335	24.267063
0.355	24.272453

0.376	24.269249
0.398	24.265995
0.422	24.263779
0.447	24.266712
0.473	24.265631
0.501	24.265068
0.531	24.262669
0.562	24.262878
0.596	24.263779
0.631	24.266308
0.668	24.263863
0.709316667	24.248009



MITTAL - CLARK LANDFILL

Data Set: C:\Documents and Settings\schmidt\ Desktop\Mittal Clark Landfill\MW-202S_1.aqt

Date: 02/24/10

Time: 12:08:42

PROJECT INFORMATION

Company: AECOM

Client: Mittal

Project: 60139029 Task 8000

Test Location: East Chicago, IN

Test Well: MW-202S Test 1

Test Date: 2/12/2010

AQUIFER DATA

Saturated Thickness: 5.76 ft

Anisotropy Ratio (K_z/K_r): 1.

WELL DATA (MW-202S_T1)

Initial Displacement: 1.295 ft

Casing Radius: 0.08333 ft

Wellbore Radius: 0.3333 ft

Well Skin Radius: 0.3333 ft

Screen Length: 10. ft

Total Well Penetration Depth: 5.76 ft

Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

$K = 0.0954$ cm/sec

$y_0 = 5.902$ ft

CLark Landfill

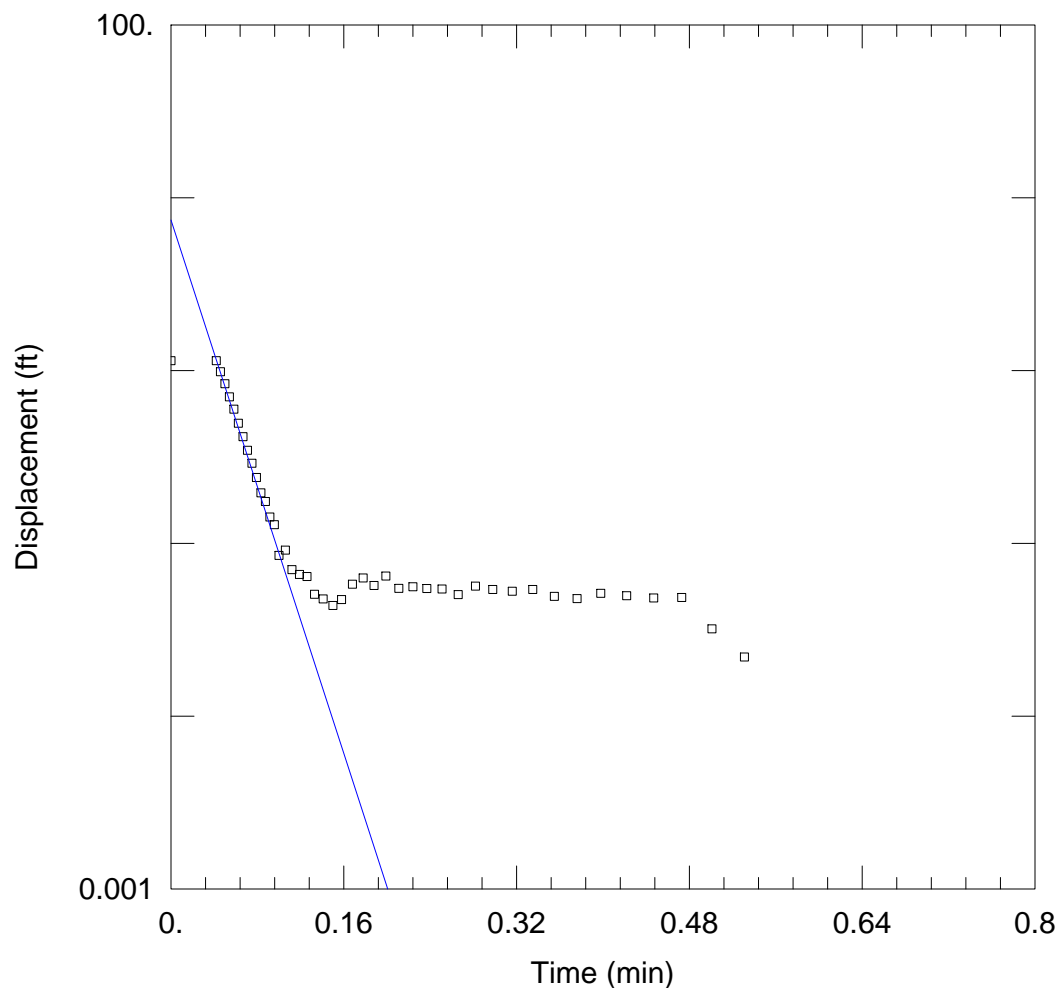
Log Name MW-202S_2

Create Date 2/12/2010 12:25

WL Initial 24.24 (ft)

Elapsed Time (Min)	Depth To Water (ft)
0	24.24
0.041966667	25.379372
0.045833333	25.223457
0.05	25.078627
0.054166667	24.944223
0.058333333	24.838152
0.0625	24.735277
0.066666667	24.654181
0.070833333	24.585398
0.075	24.530725
0.079166667	24.480509
0.083333333	24.436125
0.0875	24.414751
0.091666667	24.38201
0.095833333	24.368275
0.1	24.325222
0.106	24.331406
0.112	24.31039
0.119	24.306101
0.126	24.304255
0.133	24.290762
0.141	24.28772
0.15	24.283672
0.158	24.287313
0.168	24.297989
0.178	24.303076
0.188	24.29707
0.199	24.30468
0.211	24.294836
0.224	24.296051
0.237	24.294811
0.251	24.294445
0.266	24.290518
0.282	24.296572
0.298	24.294075
0.316	24.292843
0.335	24.294039
0.355	24.289362
0.376	24.287903
0.398	24.291374
0.422	24.289759
0.447	24.288298

0.473	24.288568
0.501	24.271999
0.531	24.261984



MITTAL - CLARK LANDFILL

Data Set: C:\Documents and Settings\schmidt\\Desktop\Mittal Clark Landfill\MW-202S_2.aqt

Date: 02/24/10

Time: 12:12:46

PROJECT INFORMATION

Company: AECOM

Client: Mittal

Project: 60139029 Task 8000

Test Location: East Chicago, IN

Test Well: MW-202S Test 2

Test Date: 2/12/2010

AQUIFER DATA

Saturated Thickness: 5.76 ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-202S_T2)

Initial Displacement: 1.139 ft

Wellbore Radius: 0.3333 ft

Screen Length: 10. ft

Gravel Pack Porosity: 0.3

Casing Radius: 0.08333 ft

Well Skin Radius: 0.3333 ft

Total Well Penetration Depth: 5.76 ft

SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

K = 0.0954 cm/sec

y0 = 7.431 ft

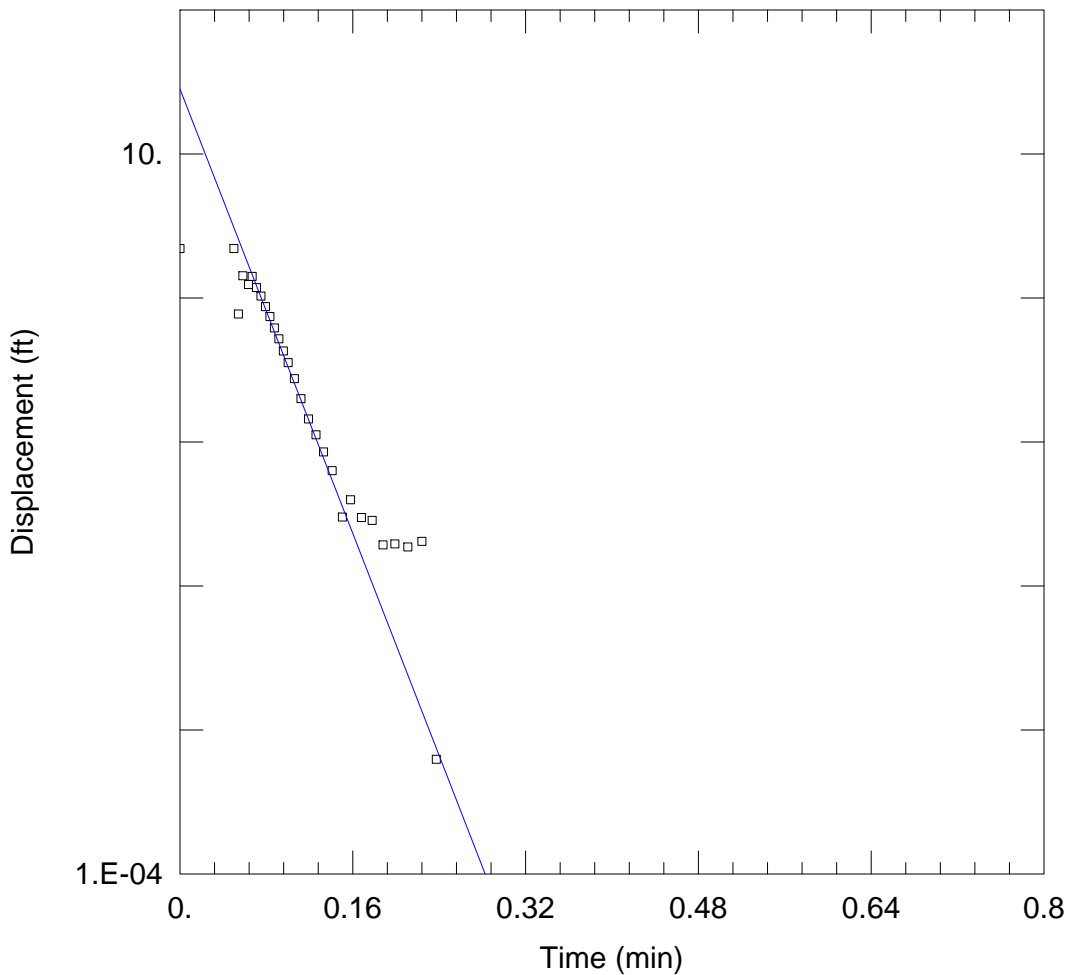
CLark Landfill

Log Name MW-202S_3

Create Date 2/12/2010 12:32

WL Initial 24.24 (ft)

Elapsed Time (Min)	Depth To Water (ft)
0	24.24
0.05	26.441223
0.054166667	25.01372
0.058333333	25.663479
0.063483333	25.479471
0.06695	25.650223
0.070833333	25.420683
0.075	25.270071
0.079166667	25.109642
0.083333333	24.982853
0.0875	24.858873
0.091666667	24.759478
0.095833333	24.668499
0.10015	24.595554
0.106	24.515116
0.112	24.439634
0.119	24.384192
0.126	24.352133
0.133	24.325283
0.141	24.303133
0.150466667	24.270105
0.158	24.279627
0.168	24.269846
0.178	24.268532
0.188	24.259281
0.199	24.259588
0.211	24.258659
0.224	24.260395
0.23745	24.240625



MITTAL - CLARK LANDFILL

Data Set: C:\Documents and Settings\schmidt\\Desktop\Mittal Clark Landfill\MW-202S_3.aqt
 Date: 02/24/10 Time: 12:16:33

PROJECT INFORMATION

Company: AECOM
 Client: Mittal
 Project: 60139029 Task 8000
 Test Location: East Chicago, IN
 Test Well: MW-202S Test 3
 Test Date: 2/12/2010

AQUIFER DATA

Saturated Thickness: 5.76 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-202S_T3)

Initial Displacement: 2.201 ft Casing Radius: 0.08333 ft
 Wellbore Radius: 0.3333 ft Well Skin Radius: 0.3333 ft
 Screen Length: 10. ft Total Well Penetration Depth: 5.76 ft
 Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
 K = 0.0954 cm/sec y0 = 28.25 ft

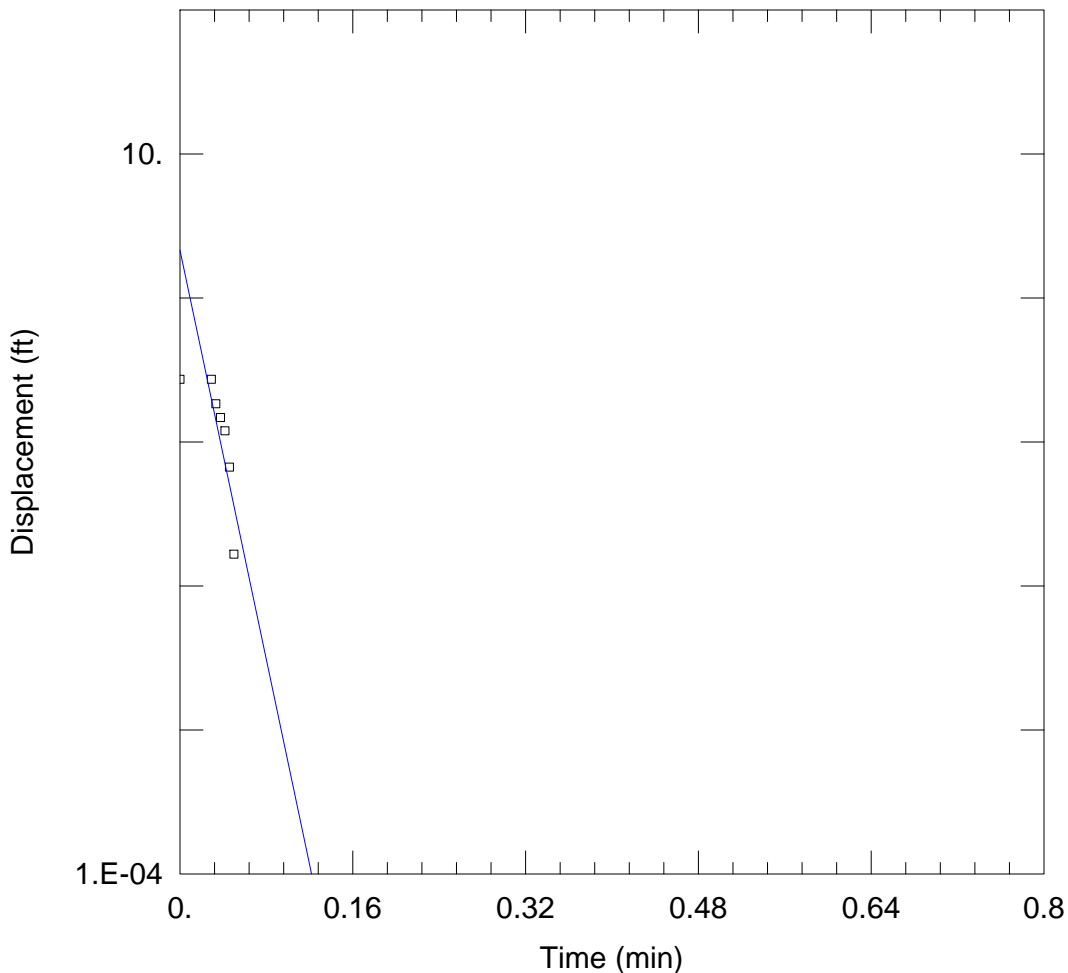
CLark Landfill

Log Name MW-203S_1

Create Date 2/12/2010 14:28

WL Initial 8.96 (ft)

Elapsed Time (Min)	Depth To Water (ft)
0	8.96
0.029166667	9.232595
0.033333333	9.144206
0.0375	9.107676
0.041666667	9.079318
0.045833333	9.026807
0.05	8.976629
0.054166667	8.94581
0.058333333	8.941437
0.0625	8.952931
0.066666667	8.952315
0.070833333	8.951104
0.075	8.954282
0.079166667	8.949895



MITTAL - CLARK LANDFILL

Data Set: C:\Documents and Settings\schmidt\ Desktop\Mittal Clark Landfill\MW-203S_1.aqt
 Date: 02/24/10 Time: 12:21:56

PROJECT INFORMATION

Company: AECOM
 Client: Mittal
 Project: 60139029 Task 8000
 Test Location: East Chicago, IN
 Test Well: MW-203S Test 1
 Test Date: 2/12/2010

AQUIFER DATA

Saturated Thickness: 6.04 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-203S_T1)

Initial Displacement: 0.2726 ft Casing Radius: 0.08333 ft
 Wellbore Radius: 0.3333 ft Well Skin Radius: 0.3333 ft
 Screen Length: 10. ft Total Well Penetration Depth: 6.04 ft
 Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
 K = 0.1783 cm/sec y_0 = 2.143 ft

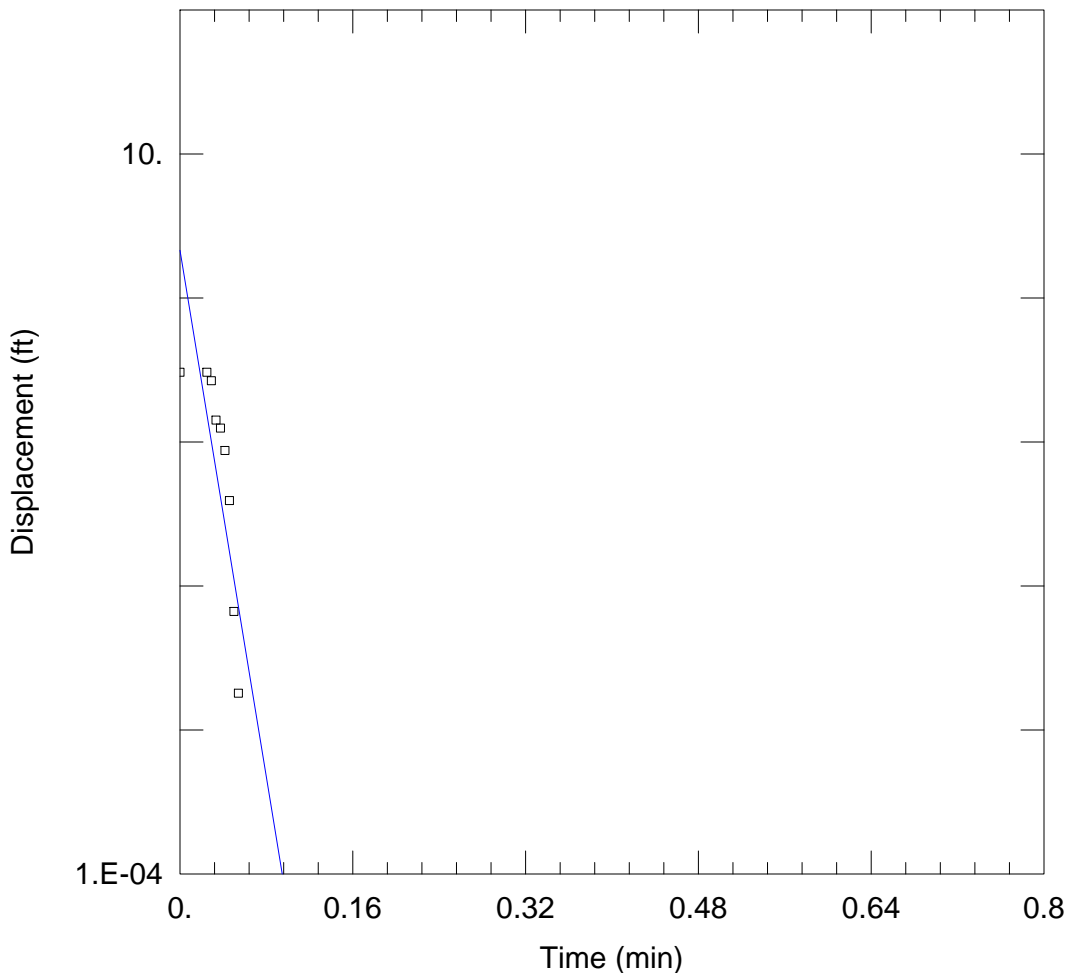
Clark Landfill

Log Name MW-203S_2

Create Date 2/12/2010 14:31

WL Initial 8.96 (ft)

Elapsed Time (Min)	Depth To Water (ft)
0	8.96
0.025016667	9.2649
0.029183333	9.225996
0.03335	9.101798
0.037516667	9.084826
0.041683333	9.047217
0.04585	8.999171
0.050016667	8.966657
0.054183333	8.961797
0.05835	8.959795
0.062516667	8.967033
0.066683333	8.966894
0.07085	8.966916
0.075016667	8.966524
0.079183333	8.96234



MITTAL - CLARK LANDFILL

Data Set: C:\Documents and Settings\schmidt\ Desktop\Mittal Clark Landfill\MW-203S_2.aqt
 Date: 02/24/10 Time: 12:25:07

PROJECT INFORMATION

Company: AECOM
 Client: Mittal
 Project: 60139029 Task 8000
 Test Location: East Chicago, IN
 Test Well: MW-203S Test 2
 Test Date: 2/12/2010

AQUIFER DATA

Saturated Thickness: 6.04 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-203S_T2)

Initial Displacement: 0.3049 ft Casing Radius: 0.08333 ft
 Wellbore Radius: 0.3333 ft Well Skin Radius: 0.3333 ft
 Screen Length: 10. ft Total Well Penetration Depth: 6.04 ft
 Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
 K = 0.2294 cm/sec y_0 = 2.143 ft

CLark Landfill

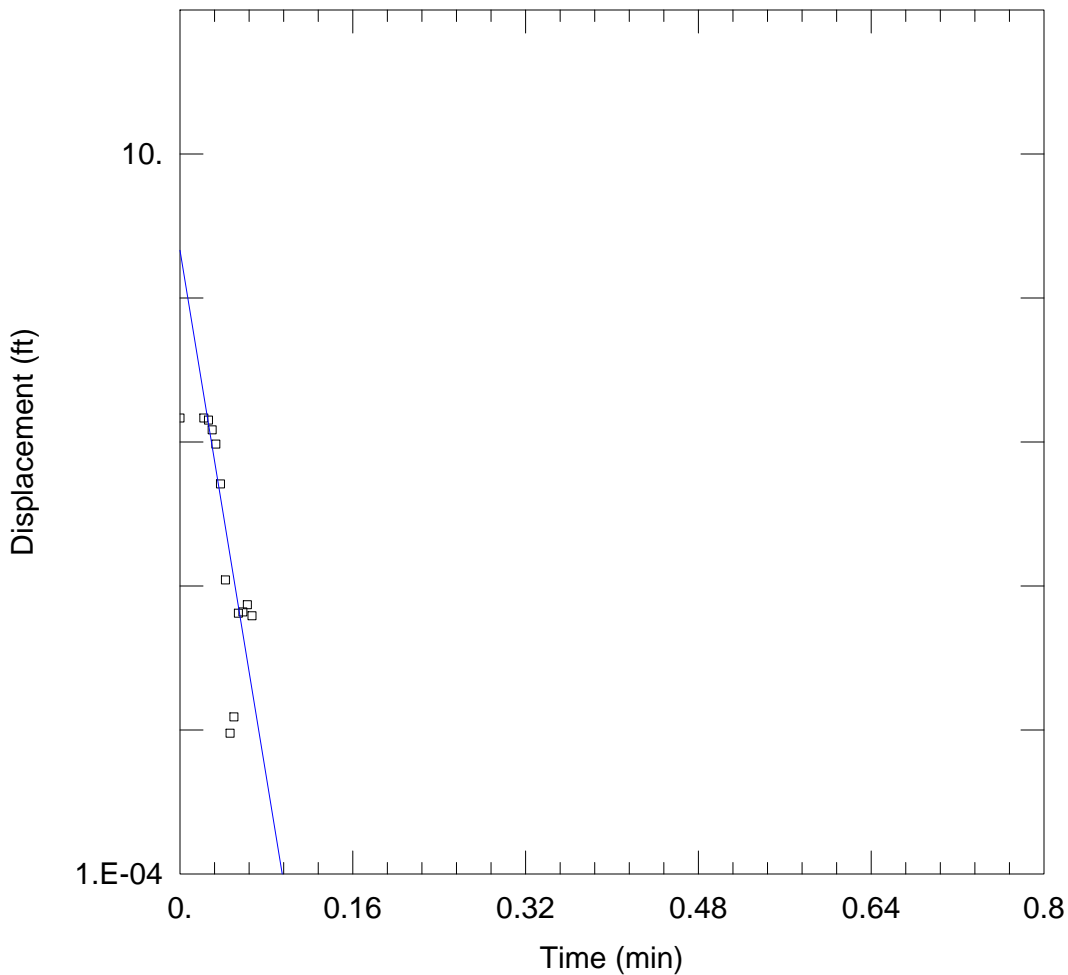
Log Name MW-203S_3

Create Date 2/12/2010 14:35

WL Initial 8.96 (ft)

Elapsed Time (Min)	Depth To Water (ft)
--------------------	---------------------

0	8.96
0.022133333	9.106685
0.026416667	9.101882
0.029816667	9.081196
0.033333333	9.056608
0.0375	9.011069
0.042083333	8.971017
0.0464	8.960949
0.05	8.961231
0.054166667	8.966467
0.058333333	8.966595
0.062416667	8.967397
0.066666667	8.966203



MITTAL - CLARK LANDFILL

Data Set: C:\Documents and Settings\schmidt\ Desktop\Mittal Clark Landfill\MW-203S_3.aqt
 Date: 02/24/10 Time: 12:32:28

PROJECT INFORMATION

Company: AECOM
 Client: Mittal
 Project: 60139029 Task 8000
 Test Location: East Chicago, IN
 Test Well: MW-203S Test 3
 Test Date: 2/12/2010

AQUIFER DATA

Saturated Thickness: 6.04 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-203S_T3)

Initial Displacement: 0.1467 ft Casing Radius: 0.08333 ft
 Wellbore Radius: 0.3333 ft Well Skin Radius: 0.3333 ft
 Screen Length: 10. ft Total Well Penetration Depth: 6.04 ft
 Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
 K = 0.2294 cm/sec $y_0 = \underline{2.143}$ ft

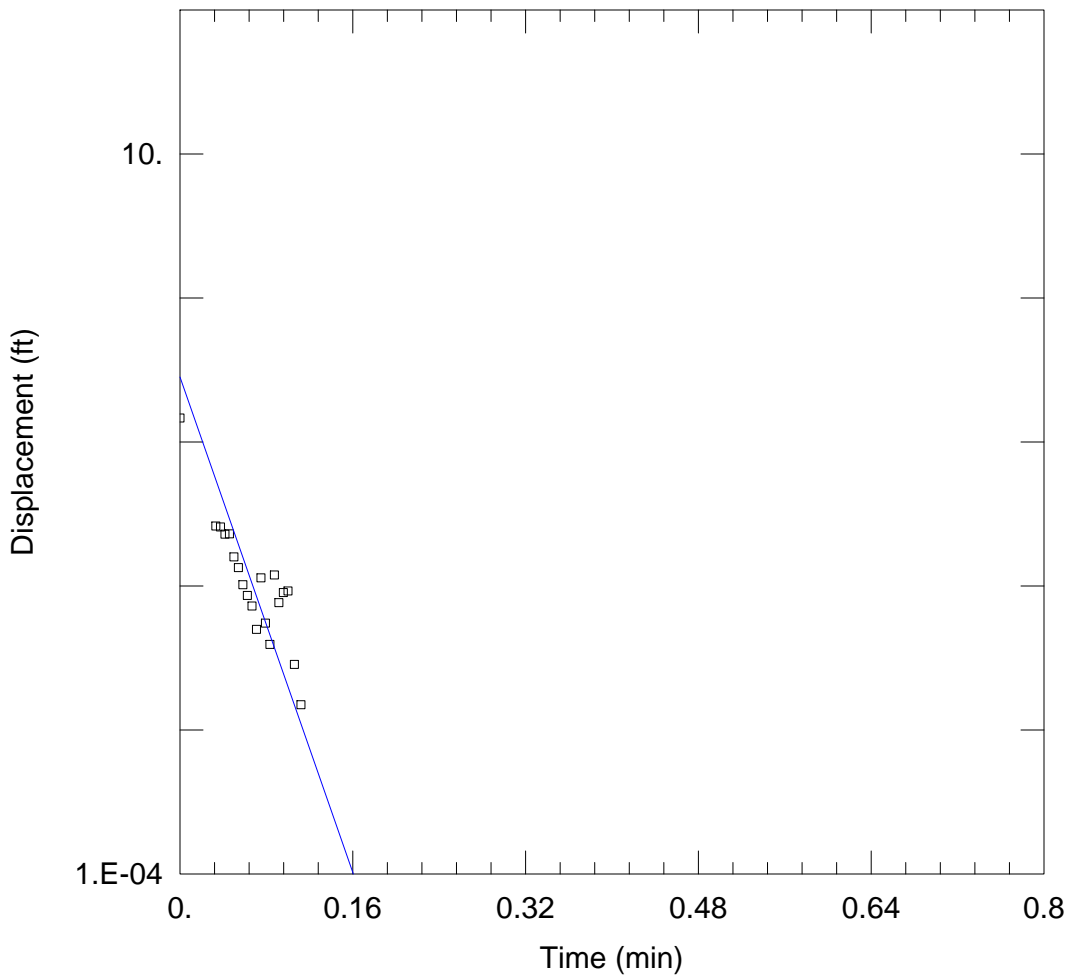
CLark Landfill

Log Name MW-204S_1

Create Date 2/12/2010 12:51

WL Initial 20.62 (ft)

Elapsed Time (Min)	Depth To Water (ft)
0	20.620001
0.033333333	20.646086
0.0375	20.645683
0.041666667	20.642859
0.045833333	20.643011
0.05	20.635923
0.054166667	20.63339
0.058333333	20.630184
0.0625	20.628582
0.066666667	20.627253
0.070833333	20.624992
0.075	20.631388
0.079166667	20.625521
0.083333333	20.623924
0.0875	20.631918
0.091666667	20.627655
0.095833333	20.628983
0.1	20.629236
0.106	20.62285
0.112	20.621498



MITTAL - CLARK LANDFILL

Data Set: C:\Documents and Settings\schmidt\\Desktop\Mittal Clark Landfill\MW-204S_1.aqt
 Date: 02/24/10 Time: 12:37:20

PROJECT INFORMATION

Company: AECOM
 Client: Mittal
 Project: 60139029 Task 8000
 Test Location: East Chicago, IN
 Test Well: MW-204S Test 1
 Test Date: 2/12/2010

AQUIFER DATA

Saturated Thickness: 4.38 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-204S_T1)

Initial Displacement: 0.1467 ft Casing Radius: 0.08333 ft
 Wellbore Radius: 0.3333 ft Well Skin Radius: 0.3333 ft
 Screen Length: 10. ft Total Well Penetration Depth: 4.38 ft
 Gravel Pack Porosity: 0.3

SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
 K = 0.09748 cm/sec y_0 = 0.2825 ft

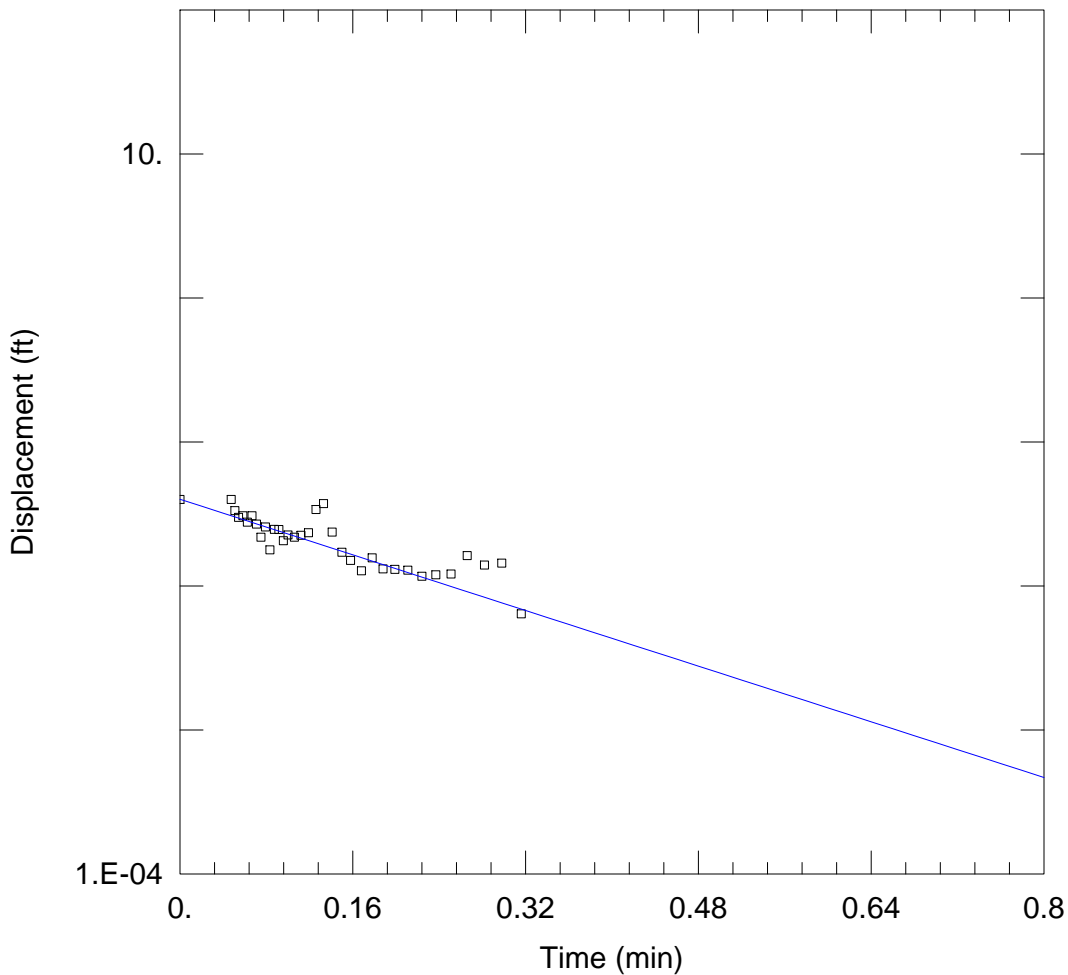
CLark Landfill

Log Name MW-204S_2

Create Date 2/12/2010 12:57

WL Initial 20.62 (ft)

Elapsed Time (Min)	Depth To Water (ft)
0	20.620001
0.033333333	20.645691
0.038066667	20.654228
0.044116667	20.654591
0.04755	20.659824
0.05095	20.653294
0.054333333	20.649918
0.058333333	20.650734
0.0625	20.647753
0.066666667	20.650734
0.070833333	20.64687
0.075	20.64179
0.079166667	20.645658
0.083333333	20.637794
0.0875	20.644726
0.091666667	20.644629
0.095833333	20.640593
0.1	20.64259
0.106	20.64179
0.112	20.642454
0.119	20.643394
0.126	20.653921
0.133	20.657265
0.141	20.643661
0.15	20.637131
0.158	20.635025
0.168	20.632729
0.178	20.635656
0.188	20.633148
0.199	20.633024
0.211	20.632858
0.224	20.631689
0.237	20.631947
0.251	20.632088
0.266	20.636219
0.282	20.633953
0.298	20.634392
0.316	20.626392



MITTAL - CLARK LANDFILL

Data Set: C:\Documents and Settings\schmidt\\Desktop\Mittal Clark Landfill\MW-204S_2.aqt

Date: 02/24/10

Time: 12:41:52

PROJECT INFORMATION

Company: AECOM

Client: Mittal

Project: 60139029 Task 8000

Test Location: East Chicago, IN

Test Well: MW-204S Test 2

Test Date: 2/12/2010

AQUIFER DATA

Saturated Thickness: 4.38 ft

Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-204S_T2)

Initial Displacement: 0.03982 ft

Wellbore Radius: 0.3333 ft

Screen Length: 10. ft

Gravel Pack Porosity: 0.3

Casing Radius: 0.08333 ft

Well Skin Radius: 0.3333 ft

Total Well Penetration Depth: 4.38 ft

SOLUTION

Aquifer Model: Unconfined

Solution Method: Bouwer-Rice

K = 0.01095 cm/sec

y0 = 0.04 ft

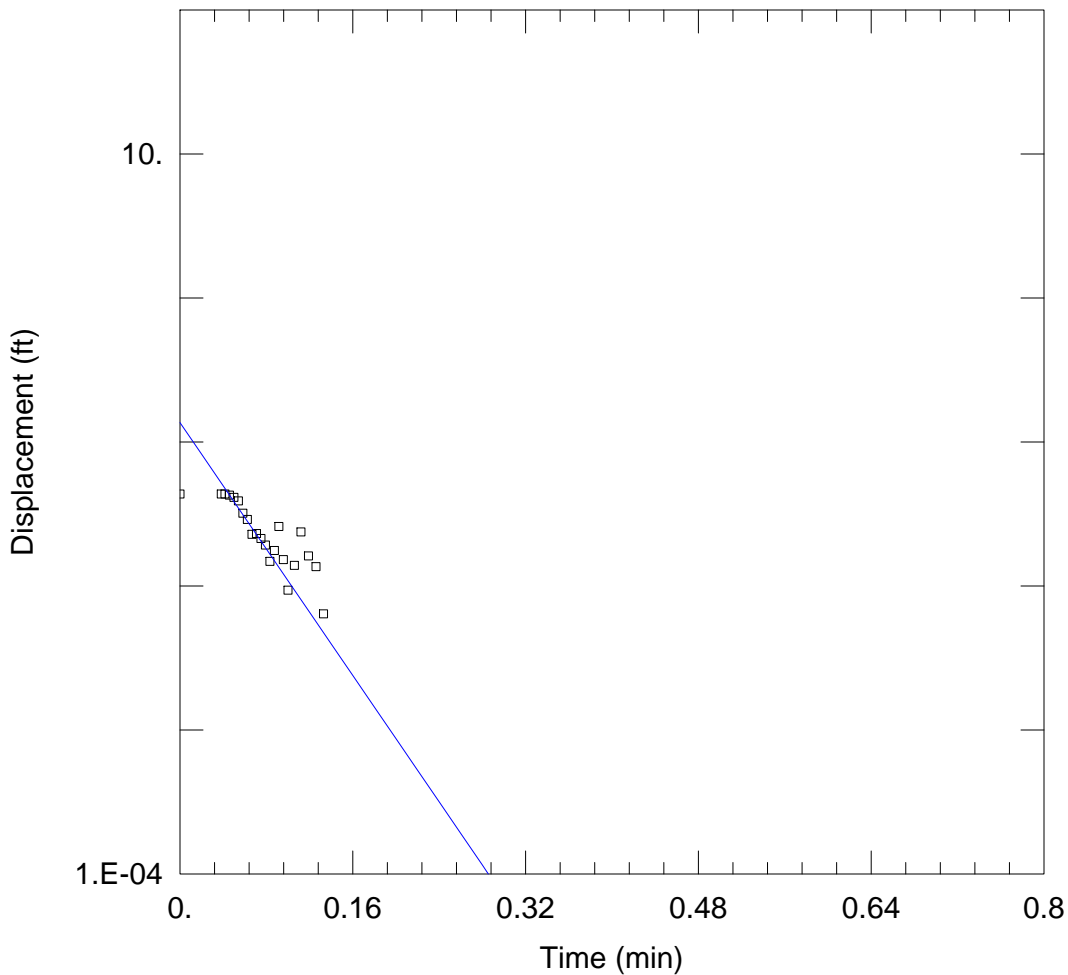
CLark Landfill

Log Name MW-204SC

Create Date 2/12/2010 13:18

WL Initial 20.62 (ft)

Elapsed Time (Min)	Depth To Water (ft)
0	20.620001
0.0383	20.663485
0.04175	20.663485
0.045833333	20.662689
0.05	20.661222
0.054166667	20.658958
0.058333333	20.652025
0.0625	20.648954
0.066666667	20.64282
0.070833333	20.643087
0.075	20.641348
0.079166667	20.639212
0.083333333	20.634823
0.0875	20.637615
0.091666667	20.645887
0.095833333	20.635229
0.1	20.629349
0.106	20.633884
0.112	20.64374
0.119	20.636145
0.126	20.633612
0.133	20.626406



MITTAL - CLARK LANDFILL

Data Set: C:\Documents and Settings\schmidt\\Desktop\Mittal Clark Landfill\MW-204S_3.aqt
 Date: 02/24/10 Time: 12:45:15

PROJECT INFORMATION

Company: AECOM
 Client: Mittal
 Project: 60139029 Task 8000
 Test Location: East Chicago, IN
 Test Well: MW-204S Test 3
 Test Date: 2/12/2010

AQUIFER DATA

Saturated Thickness: 4.38 ft Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (MW-204S_T3)

Initial Displacement: 0.04349 ft Casing Radius: 0.08333 ft
 Wellbore Radius: 0.3333 ft Well Skin Radius: 0.3333 ft
 Screen Length: 10. ft Total Well Penetration Depth: 4.38 ft
 Gravel Pack Porosity: 0.3

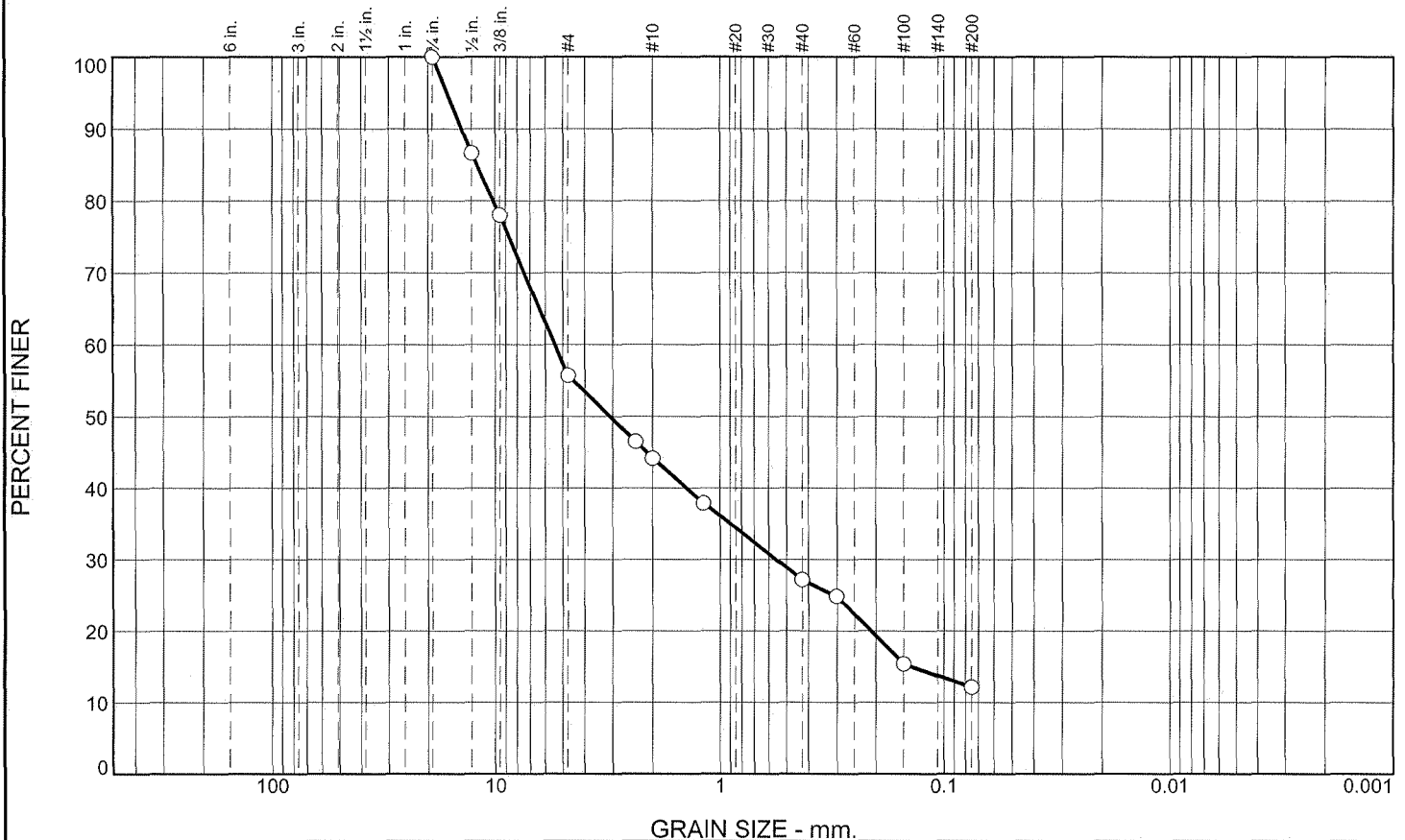
SOLUTION

Aquifer Model: Unconfined Solution Method: Bouwer-Rice
 K = 0.04974 cm/sec y_0 = 0.1361 ft

Appendix F

Grain Size Analyses

Sieve Analysis of Fine and Coarse Aggregates ASTM C136



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	44.3	11.5	17.0	15.1	12.1	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	86.7		
.375	78.1		
#4	55.7		
#8	46.5		
#10	44.2		
#16	37.9		
#40	27.2		
#50	24.8		
#100	15.4		
#200	12.1		

* (no specification provided)

Material Description		
Slag		
PL=	Atterberg Limits LL=	PI=
D ₉₀ = 14.0525	Coefficients D ₈₅ = 12.0098	D ₆₀ = 5.4265
D ₅₀ = 3.0766	D ₃₀ = 0.5564	D ₁₅ = 0.1380
D ₁₀ =	C _u =	C _c =
USCS=	Classification AASHTO=	
Remarks		

Source of Sample: MW-2015

Depth: 22-27

Date: 7/12/10

AECOM

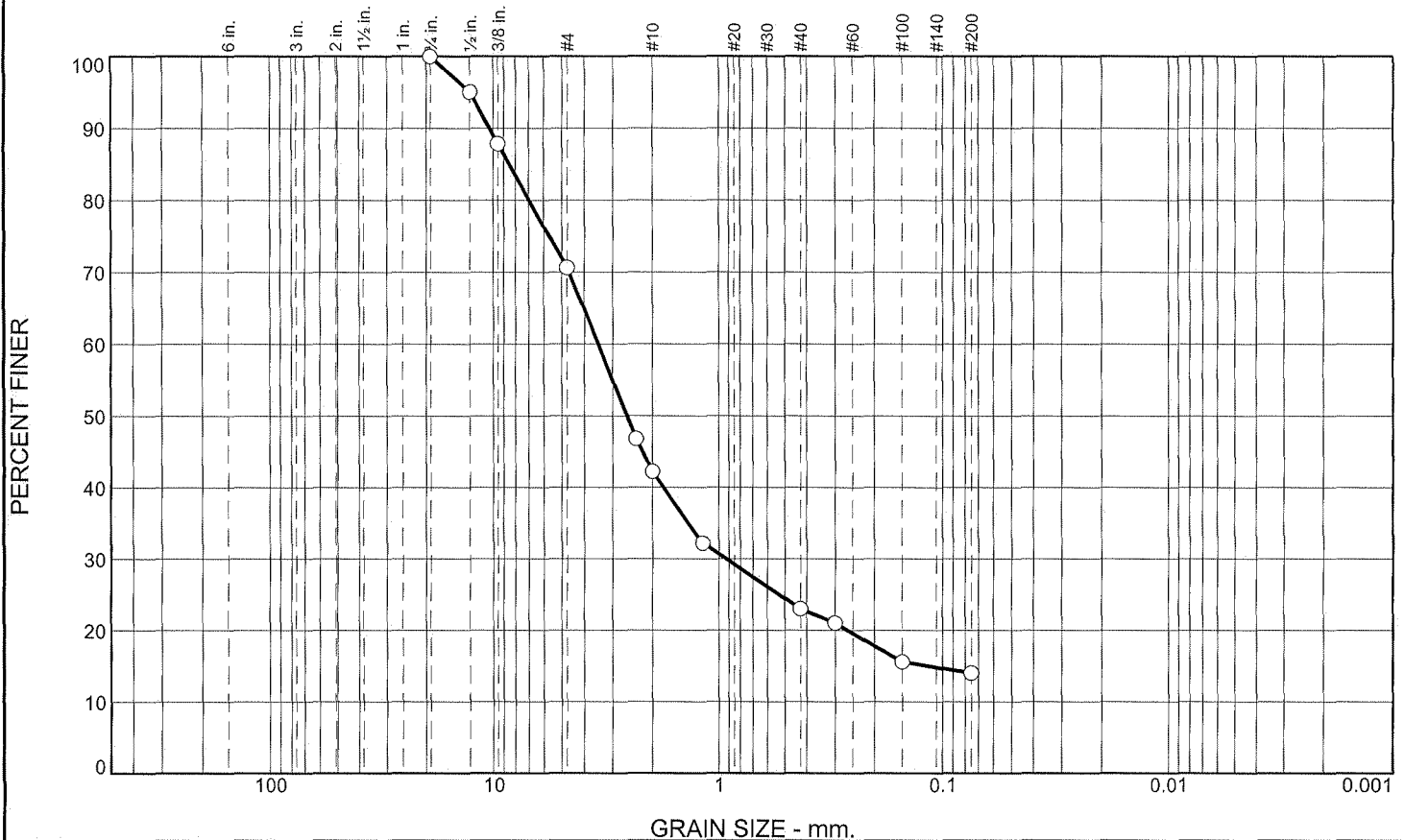
Client:
Project: Clark Landfill

Project No: 60141376

Figure

Tested By: JRT

Sieve Analysis of Fine and Coarse Aggregates ASTM C136



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	0.0	29.3	28.5	19.2	9.0	14.0	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
.75	100.0		
.5	95.0		
.375	87.9		
#4	70.7		
#8	46.8		
#10	42.2		
#16	32.2		
#40	23.0		
#50	21.0		
#100	15.6		
#200	14.0		

* (no specification provided)

Material Description

Slag

PL= **Atterberg Limits** PI=

LL=

Coefficients

D₉₀= 10.3775 D₈₅= 8.4855 D₆₀= 3.4747

D₅₀= 2.5910 D₃₀= 0.9253 D₁₅= 0.1156

D₁₀= C_u= C_c=

Classification

USCS= AASHTO=

Remarks

Source of Sample: MW-2025

Depth: 22-30

Date: 7/12/10

AECOM

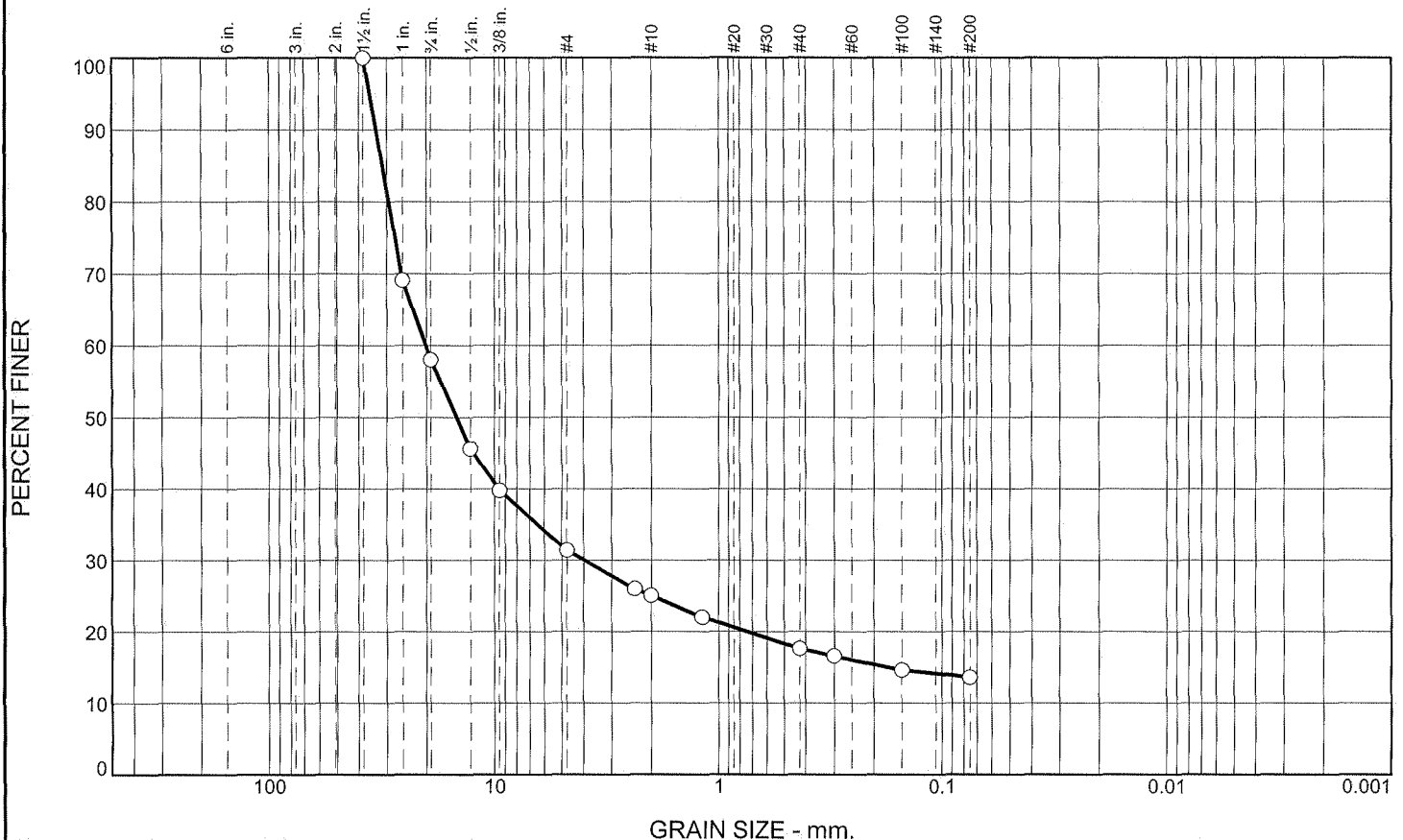
Client:
Project: Clark Landfill

Project No: 60141376

Figure

Tested By: JRT

Sieve Analysis of Fine and Coarse Aggregates ASTM C136



% +3"	% Gravel		% Sand			% Fines	
	Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
0.0	41.9	26.7	6.3	7.4	4.1	13.6	

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
1.5	100.0		
1	69.1		
.75	58.1		
.5	45.6		
.375	39.8		
#4	31.4		
#8	26.0		
#10	25.1		
#16	22.0		
#40	17.7		
#50	16.6		
#100	14.6		
#200	13.6		

* (no specification provided)

Material Description		
Slag		
Atterberg Limits		
PL=	LL=	PI=
Coefficients		
D ₉₀ = 33.4153	D ₈₅ = 31.2936	D ₆₀ = 20.0361
D ₅₀ = 14.6475	D ₃₀ = 3.9664	D ₁₅ = 0.1702
D ₁₀ =	C _u =	C _c =
Classification		
USCS=	AASHTO=	
Remarks		

Source of Sample: MW-2045

Depth: 20-26

Date: 7/12/10

AECOM

Client:

Project: Clark Landfill

Project No: 60141376

Figure

Tested By: JRT